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Editorial

INNOVATIONS

OBSTETRIC CLINIC, MODERN OPERATIVE TECHNICS AND PRACTICAL SURGICAL SUGGESTIONS

IN this issue we begin the first of three new departments called Obstetric Clinic, Modern Operative Technics and Practical Surgical Suggestions.

The first of fifteen planned articles to be published in the department called Obstetric Clinic appears in this number. These articles are designed to raise the standard of maternal care and to reduce maternal mortality.

The question might well be asked: "Why such articles in a surgical journal?" In many places throughout our country surgeons serving their communities are called upon to handle obstetric complications. They are the operators who must do forceps deliveries, versions and cesarean sections. These men, by and large, are well trained in surgical technic but have not been trained in obstetrics and, therefore, may lack sufficient obstetric judgment. Inasmuch as some of our readers might be included in this group, we are offering this series of articles in the hope that it will prove of value to the surgeon in facilitating a decrease in maternal morbidity and especially maternal mortality.

Not so long ago our country had a maternal death record that was higher than necessary. Other countries were much better off than we were. Then, in Philadelphia in 1930 the President of the Philadelphia County Medical Society appointed a committee to study the cause of obstetric deaths and to make recommendations designed to correct the situation. We read, "After some preliminary discussion it was determined to follow the line of survey and analysis then in progress by the Committee on Public Health Relations of the New York Academy of Medicine in order that the reports of the two committees might be comparable." The Philadelphia report was published in 1934. The New York Academy of Medicine began its work in 1930 and its report came out in 1933. As a result the idea to raise obstetric standards throughout the country was taken up in many centers. The Brooklyn committee was organized in 1934. Dr. Charles A. Gordon was appointed Chairman and has held that position to date. He and his co-workers worked out a practical plan aimed to instruct and make for better midwifery care. Briefly their plan was as follows: From the Department of Health they received notice of all maternal deaths. Then a full and detailed history of such deaths was made. At each meeting certain cases were selected for presentation and discussion. In every instance the patient, the doctor in charge of the patient and the institution were absolutely anonymous. The idea was not to condemn and criticize but to discover what could have been done or what could have been avoided which might have changed the end result. The value of such case presentations caught on almost immediately, and in recent years it has not been unusual for several hun-

dred physicians to attend the meetings. It is from the voluminous amount of material in the hands of this committee that this series in our Journal is possible.

We are fortunate that Dr. Gordon consented to supervise these articles. Until he was made Emeritus Professor recently, he was Professor of Obstetrics and Gynecology at The Long Island College of Medicine. This college was taken over by the Educational Department of New York State and now is known as the State University of New York College of Medicine. At present Dr. Gordon is Emeritus Professor of Obstetrics and Gynecology at this institution. Dr. Rosenthal, Assistant Professor of Clinical Obstetrics and Gynecology, and Dr. O'Leary, who teaches at the College Division of Kings County Hospital, have been in Dr. Gordon's department and are his active right hand workers on the Maternal Mortality Committee.

These special articles in the Obstetric Clinic will appear every other month. We sincerely trust that the reader, if interested, will find the articles, presented in a new and different manner, valuable and helpful in his daily work. The subjects to be covered are: (1) Rupture of the uterus; (2) Postpartum hemorrhage; (3) Anesthesia; (4) Placenta previa; (5) Pre-eclampsia and eclampsia; (6) Cesarean section; (7) Thrombophlebitis and embolism; (8) Abortion; (9) Ectopic pregnancy; (10) Diabetes; (11) Cardiac disease; (12) Tuberculosis; (13) Pelvic tumors; (14) Hypertension and chronic nephritis and (15) Puerperal infection.

In the October issue of this Journal the second new department, Modern Operative Technics, will be inaugurated. Like medicine, surgery has been making huge strides and, from all indications, promises even to quicken its pace. Because of this rapid progress, we will present the technic of one of the newer operations or the latest modifications of standard surgical procedures every other month. Emphasis will be placed on preoperative care. The surgical technic will be outlined step by step; this will be clarified by comprehensive illustrations. Postoperative care will be given adequate consideration, especially the complications or unusual sequalae common to that particular procedure. Some of the operative technics to be published are: a method of treating vesico-vaginal fistula following total hysterectomy, operation for the cure of Hirschsprung's disease, removable of the mandible, and modifications of the Manchester-Fothergill operation for uterine prolapse.

The third new feature to appear in the Journal will be known as Practical Surgical Suggestions. We have received many short manuscripts in which the authors tell of helpful surgical aids they employ in their daily work. These "tricks" or "aids" are rarely found in textbooks. They are the things one learns from experience, from watching others and from "shop talk" in the operating room, ward or staff room. These to-the-point, brief, practical suggestions will appear from time to time. We believe that nearly every reader will turn to this department before closing the Journal.

We welcome suggestions concerning any or all of these new departments. We hope that these additions to our present departments (Editorials, Original Articles, Streamlined Articles, Case Reports, New Instruments and Outside the Ivory Tower) covering the various surgical specialties, together with issues devoted to the transactions of The American Association for the Surgery of Trauma and The American Proctologic Society, will create in our readers the feeling that they are offered an up-to-the-minute, practical surgical fare.

T. S. W.

Obstetric Clinic

THE woman about to become a mother or with a new-born infant upon her bosom, should be the object of trembling care and sympathy wherever she bears her tender burden, or stretches her aching limbs. The very outcast of the streets has pity upon her sister in degradation, when the seal of promised maternity is impressed upon her. The remorseless vengeance of the law brought down upon its victims by a machinery as sure as destiny, is arrested in its fall at a word which reveals her transient claim for mercy. The solemn prayer of the liturgy singles out her sorrows from the multiplied trials of life, to plead for her in her hour of peril. God forbid that any member of the profession to which she trusts her life, doubly precious at that eventful period, should hazard it negligently, unadvisedly or selfishly.

OLIVER WENDELL HOLMES

1st of the Series

RUPTURE OF THE UTERUS

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The teaching of the treatment of major complications in obstetrics is difficult. The usual method of instruction consists of text books, attendance at lectures and limited clinical demonstrations. Actual contact with patients and careful observation of the clinical course and effect of treatment constitute the most effective method for the teaching of both normal and abnormal obstetrics. Certain complications occur so infrequently in the experience of the general practitioner and opportunities for witnessing them are so limited that this actual experience is not possible for many. Even house staff officers may never see patients with certain serious complications such as eclampsia and rupture of the uterus. We have long believed that there is merit in presenting the practical clinical aspects of major obstetric complications by reviewing pertinent case reports of maternal deaths that have actually occurred. It may be second in educational value to actual contact with patients.

We are not alone in our estimation of the value of case presentations. Eastman has been publishing such case reports with editorial comment in the "Obstetrical and Gynecological Survey." We intend, however, to use our material somewhat differently. For more than thirteen years case reports of maternal deaths have been presented to a medical audience for discussion of possible controllable factors resulting in death of the patient. Discussions have been lively and stimulating and occasionally have resulted in the promulgation of definite principles in the diagnosis and therapy of obstetric complications.

Within the past few years we have, on occasion, confined the case reports presented at a single meeting to one important obstetric subject. This has often proved to be especially effective. We shall in this and future articles present case reports in this manner and shall simulate meetings by supplementing case presentations with questions and answers. The list of subjects to be covered follows; these we may later add to or vary from slightly: rupture of the uterus, postpartum hemorrhage, anesthesia, placenta previa, pre-eclampsia and eclampsia, cesarean section, thrombophlebitis and embolism, abortion, ectopic pregnancy, diabetes, cardiac disease, tuberculosis, pelvic tumors, hypertension and chronic nephritis and puerperal infection.

The data on these cases had been secured originally for the purpose of analysis of these

deaths by a subcommittee of the Committee on Maternal Welfare of the Medical Society of the County of Kings. All maternal deaths occurring in Brooklyn, a borough with a population of nearly three million, are reviewed by the Committee. When the Department of Health of the City of New York receives a death certificate indicating the occurrence of pregnancy, a photostatic copy is sent to the Committee. Clinical data are then obtained, regardless of where the death occurred, whether in city, private or small proprietary hospitals, or at home. When the death is discussed at meetings, the hospital, doctor and patient remain anonymous. For obvious reasons, too, we have made it impossible to identify any particular patient. While the broad clinical aspects of each case have been preserved, other details will either be omitted or changed. It is hoped that the presentation of these untoward results in obstetric cases will not result in gaining too poor a reputation for the quality of obstetric care in our community. They could probably be duplicated in any other area. Actually, the maternal mortality rate in Brooklyn for the past few years has been extraordinarily low.

CASE I. The patient was a forty year old white female who had been delivered previously of fourteen babies. About one week before term she had a fall at home landing on her left side, for which she was hospitalized for four days and then discharged apparently in good condition. The onset of labor occurred at term and she was admitted to the hospital after twelve hours of labor. Membranes were ruptured inadvertently at the time of initial rectal examination. The patient was markedly obese and showed a marked diastasis recti. The axis of the uterus was not in relation to the axis of the pelvic brim. A vertex presentation was definitely diagnosed. Labor continued after admission to the hospital, and four hours after admission slight vaginal bleeding was noted. Shortly afterward the fetal heart, which had been heard previously, was no longer heard. Labor ceased and the patient was less distressed; it was believed that a dose of morphine which had been given an hour before was taking effect. However, the patient soon began to show evidence of shock. Vaginal examination disclosed a foot presenting and a tongue of placenta protruding into the vagina. A spontaneous version with separation of the placenta was diagnosed and the patient treated with intravenous glucose and two blood transfusions of 500 cc. each. A diagnosis of ablatio placenta was made. She died a little more than four hours after the onset of her vaginal bleeding.

Post-mortem examination showed the head and shoulders of the fetus extending through a large tear in the left lower uterine segment. The placenta was still implanted in the uterus.

CASE II. The patient was a forty year old colored obese female, para VII, with a negative history except for dilation and curettage of the uterus ten months previously. The findings were essentially normal during her prenatal course. She was admitted to the hospital at term and in labor at 1:45 A.M. She stated that pains had started at 12 A.M. and her bag of waters had ruptured spontaneously at that time. During examination there was a very strong uterine contraction so that the uterus stood out and the patient rapidly went into shock. She became excited and began to sweat profusely. The blood pressure was 50/20. Abdominal examination disclosed the fetus to be directly under the abdominal wall and lying obliquely. The uterus was felt on the left. Vaginal bleeding was slight. The fetal heart was not heard and labor had ceased.

At 3:30 A.M. the patient was seen by the attending physician who found her in extreme shock. The diagnosis of ruptured uterus was made. Immediate treatment for shock and transfusion were advised with laparotomy right afterward. Intravenous glucose was given but there was some delay in obtaining blood for transfusion. The patient was brought to the operating room at 4:45 A.M. but died before the operation was begun.

Post-mortem examination showed 3,000 to 4,000 cc. of blood in the peritoneal cavity with fetus and placenta lying free on the right side and a well contracted uterus on the left. The rent in the uterus was in the lower uterine segment on the right and extended upward and out into the broad ligament.

Questions. (1) How serious is rupture of the uterus? How frequent? (2) How can a diagnosis of spontaneous rupture of uterus be made? (3) Is multiparity a predisposing factor? (4) What is the significance of shock during labor? (5) What is the significance of the delay in blood transfusion?

Comments. Rupture of the uterus during pregnancy or labor is the most serious obstetric complication. If untreated its mortality approaches 100 per cent for the mother and the

undelivered fetus. With treatment it has a maternal mortality of about 50 per cent. Since it appears to occur infrequently, the average doctor who practices obstetrics may never see or hear of a case. The possibility of its occurrence in his own patient may never occur to him and this leads to dangerous delay in diagnosis. Like ectopic pregnancy the diagnosis would be made more frequently if it were thought of.

The frequency of rupture of the uterus varies directly with the quality of obstetric care. When predisposing factors are recognized during the prenatal period and the management of labor proper, this complication is rarely seen except as a result of prior cesarean section or spontaneous rupture in the "grande multipara."

Multiparity is a predominant predisposing factor, especially if there has been any interference or marked difficulty at a previous labor. The residua of previous labors may include cervical and myometrial scars. Prior operative procedures such as curettage of the uterus as in Case I or manual removal of the placenta may cause more severe myometrial scarring than spontaneous delivery. The multipara who has previously had several normal spontaneous labors is not ordinarily regarded with apprehension; yet she is predisposed to uterine rupture, especially if she is obese and has a pendulous abdomen or if other cause for a deviated parturient axis is present.

The occurrence of shock during labor is of the greatest significance. In the absence of sufficient hemorrhage or operative trauma to account for it it must be regarded as due to rupture of the uterus. When noted during labor and associated with slight vaginal bleeding, loss of the fetal heart, cessation of contractions and the palpation of the fetus directly beneath the abdominal wall or spontaneous version of the fetus, it is absolutely diagnostic.

Adequate and timely transfusion of blood is of the greatest importance. In Case II in which massive intra-abdominal hemorrhage of 3,000 to 4,000 cc. occurred it is clear that prompt blood replacement was essential. Early diagnosis is not sufficient. Delay in transfusion will lead to irreversible shock when nothing will avail. Adequate amounts of Rh negative blood must be available wherever women are confined.

CASE III. The patient was a thirty-six year old markedly obese white female, gravida IV, para III, who entered the hospital because of swollen ankles and headaches for three weeks. She had no prenatal care. Her past history included an abortion at two months and a difficult forceps delivery of her first baby with deep cervical laceration. She was about thirty-seven weeks' pregnant. On examination she was in good general condition. The fetus was in vertex presentation and the fetal heart was heard. The blood pressure was 144/90 and there was 1 plus albuminuria. A diagnosis of toxemia was made and she was treated conservatively with restrictions in her diet and magnesium sulfate daily by mouth. Within a few days her blood pressure fell to almost normal levels and the albuminuria disappeared.

One week after admission she suffered a painless hemorrhage of about 200 cc. of bright red blood. Examination showed a few contractions rather than true labor. The uterus was not tender and the fetal heart was heard. The blood pressure was 130/84. A sterile vaginal examination showed no placenta. The membranes were artificially ruptured. At this time the cervix was dilated about 4 cm. and the vertex fitted well into it.

Labor began but was of the inertia type. There was little further bleeding and glucose and sedation were ordered because of the fatigue of the patient and poor pains. The next day she appeared to be unduly restless. The fetal heart could not be heard but this was attributed to the patient thrashing about rather than to death of the fetus. A few hours later she was acutely ill and in shock. The blood pressure was not obtainable. A transfusion of 1,000 cc. of blood was given, with some improvement in her condition. The presence of the head in the pelvis, a globular mass in the right side of the abdomen, easily palpable fetal parts to the left and absence of the fetal heart made the diagnosis of rupture of the uterus.

Laparotomy was begun with the patient almost moribund. A second transfusion was started. The fetus, placenta and about 500 cc. of blood were found free in the peritoneal cavity. The uterus was contracted and pushed to the right. There was a tear beginning about in the middle of the corpus on the left and extending inferiorly to include the entire cervix. Rapid supravaginal hysterectomy was performed and the cervical tear repaired. The patient died before the abdomen was closed.

Case IV. The patient was a thirty-seven year old multipara who had been delivered of three babies previously. Labor began at term at home and after three hours of labor the membranes ruptured. At this time the cervix was dilated 7 cm., the head was above the spines and the contractions were strong. It was noted that the abdomen was very pendulous and the vulva edematous. Two hours later the edema was markedly increased and at the same time a mass about the size of a large grapefruit was palpated in the region of the fundus. Coincidentally with the appearance of the mass the pains diminished in intensity and frequency, the pulse rose to 140 and the patient showed evidence of mild shock. She was catheterized and ½ ounce of bloody urine was obtained. The mass in the fundus was then noted to increase slowly in size.

The patient was not admitted to the hospital until five and a half hours after the mass was first observed; at that time she was in shock. A diagnosis of rupture of the uterus was made and laparotomy was begun about two hours later. At operation about 4 ounces of bloody serum were found in the peritoneal cavity. The lower uterine segment was ecchymotic and a large hematoma extended through the right broad ligament to the cecum. A right lateral tear in the lower segment of the uterus was noted. The uterus was incised anteriorly and a stillborn fetus and placenta extracted. Supravaginal hysterectomy was then performed and the abdomen closed. Transfusion was given during the operation. Postoperatively the patient developed pneumonia and died after fifteen days. Microscopic examination of the excised uterus showed many small fibromyomas; large areas of hyalinization were also noted.

Question. What was the cause of rupture of the uterus in these two cases?

Comments. In Case III the cervical scar probably yielded, with extension through the lower segment into the fundus. Cervical scars and marked deviations of the uterine axis such as occurred with a markedly pendulous abdomen in Case IV must be regarded as strong predisposing factors for uterine rupture.

Case V. The patient was a thirty-seven year old white female, gravida IV, para II, who was admitted at term shortly after rupture of the membranes. Labor started nineteen hours later. The contractions were slight and irregular. The presentation was vertex and the fetal heart tones were normal. The cervix was partially effaced and dilated 3 cm. The lowest level of the vertex was about 3 cm. above that of the ischial spines.

She was given three doses of 1 m. each of pituitrin at twenty-minute intervals. Her pains became stronger and after two hours the cervix was dilated 4 cm. and the vertex was at minus 2. Three more doses of pituitrin were given as before. However, at the end of this period of stimulation she was found to be cyanotic. The vertex was still at minus 2 and the cervix was dilated 6 cm. A diagnosis of ruptured uterus was made and operation begun one hour later.

At operation a rent in the right posterior lower segment of the uterus was found. It extended into the right broad ligament with free and clotted blood between its folds and in the retroperitoneal space behind the cecum. The uterus was opened and a stillborn fetus extracted. Supravaginal hysterectomy and a right salpingo-oophorectomy were performed. The patient was in deep shock during the operation, no blood pressure being obtainable. She died two hours later. Blood transfusions totaling 3,000 cc. had been given.

Case VI. This patient was a thirty-three year old female, gravida V, para IV, who was admitted to the hospital at term with a history of rupture of membranes three hours prior to admission. Her prenatal course during the present pregnancy had been uneventful except that a transverse presentation had been suspected three weeks prior to the onset of labor. X-ray examination at that time showed "a large single fetus, essentially a frank breech with a transverse tendency in a normal gynecoid pelvis."

After admission to the hospital pains were weak and irregular for about ten hours following which the patient had strong three-minute pains for about one hour. At this time the umbilical cord prolapsed through the vaginal introitus. The patient was draped and examined by the physician in charge who found that the arm also had prolapsed into the vagina. He reposited the cord through the cervix which was dilated about 6 cm. An obstetric consultant found the patient dehydrated and somewhat exhausted; about 300 cc. of blood were on a vulvar pad and a few small clots were present in the vagina. The

hand and cord were still presenting in the vagina. The hand was reposited and the vertex which was found in the right lower quadrant was pushed over the inlet and an abdominal binder applied; there was no evidence of placental tissue at this time. The diagnosis was transverse presentation with partial separation of the placenta. The patient was given plasma and returned to bed.

One hour later, as there was no further bleeding or contractions, pituitrin in 1 mm. doses was ordered. After the second dose contractions became strong, occurring every four minutes. At the end of each contraction the patient began to have spurts of bright red vaginal bleeding. She became pale and the pulse more rapid. A second vaginal examination at this time revealed the vertex again displaced with the cervical os partially covered by placental tissue. The consultant then performed an easy version but did not attempt extraction. The patient received her third bottle of plasma and her condition was described as poor.

Throughout the remainder of the day she was treated for shock and that evening her condition was described as greatly improved. Her blood pressure was 104/80, pulse 120 and her temperature 99.2°F. The patient at no time during this day had any contractions despite the administration of twelve doses of pituitrin. Morphine and sulfadiazine were administered. Since the patient had had no uterine contractions, slight traction was made on the presenting leg but with no progress. In view of the patient's critical condition no further operative interference was thought to be indicated. Penicillin therapy was then instituted. Sulfadiazine was discontinued as the patient had not voided in thirty-six hours. On the third day following the version her condition was still critical and there were signs of generalized peritonitis. Her condition became gradually worse and she expired the following day undelivered.

At autopsy the peritoneal cavity was found to contain about 3,000 cc. of blood. A fetus weighing 3,900 gm. was found lying partly free in the peritoneal cavity. There was a rent in the left lateral wall about 13 cm. through which the placenta was protruding. The placenta was attached to the right upper fundus.

Questions. (1) When did rupture occur in Case VI? (2) What should have been done for the patient in Case VI? (3) Is the administration of pituitrin ever indicated in the treatment of uterine inertia? (4) What is the active treatment of rupture of the uterus? (5) Is the administration of plasma advisable? (6) Did lower nephron nephrosis occur?

Comments. It is not certain when rupture occurred in Case VI. It may have occurred prior to the use of the oxytocic since vaginal bleeding and exhaustion were noted fourteen hours after the membranes ruptured and after eleven hours of labor in a patient with a transverse presentation. It is certain that if rupture did not occur earlier, it must have occurred after the administration of pituitrin and the version when shock was apparent. In retrospect it would appear that the best treatment for transverse presentation of a large fetus after the onset of labor, even in the multipara, is cesarean section.

Experience has shown danger in the use of posterior pituitary extract or other oxytocics during pregnancy and labor. Rupture of the uterus due to its injudicious use still occurs, and unfortunately there are some who can learn only by tragic experiences of their own. Even as small a dose as 1 m. may produce rupture; yet there is increasing evidence that minute doses of pituitrin may be given with relative safety and effectiveness in carefully selected cases of uterine inertia that might otherwise result in considerable morbidity or even mortality.

If certain criteria are met, safety in the use of the drug will be increased. These criteria are: (1) There must be no obstruction to spontaneous delivery. Cephalopelvic disproportion and malpresentations such as transverse presentations are definite contraindications. (2) The "grande multipara" must not be given the drug, nor must any multipara in whom dense cervical scarring is present. (3) The medication should be given under careful supervision and one should be prepared to administer ether or chloroform if uterine tetany occurs. (4) If given intramuscularly the initial dose should not exceed ½ m. The intravenous drip method is the method of choice. It delivers almost infinitesimal yet effective doses, and the action of the drug can be stopped promptly. Pituitrin, 1½ m., is added to 500 cc. of 5 per cent glucose in water and the drip started at about thirty-five drops per minute. The rate of flow may be increased or the concentration

of the pituitrin increased to 3 m. in 500 cc. if necessary.

As a rule complete rupture of the uterus will result in death unless adequate treatment is instituted within a few hours. *The cardinal principles of good treatment are massive transfusion and immediate operation.* This patient should have been operated upon at the very latest when shock was stated to be greatly improved although shock is no contraindication to surgery in this condition. If the uterine laceration is irregular and ragged, supravaginal hysterectomy will be necessary, the ovaries being conserved. The operation should be performed with speed and gentleness with little attention to refinements of technic. In apparently hopeless cases operation may consist only of rapid excision of the uterus between broad ligament clamps and abdominal closure with through and through interrupted sutures. The clamps may be removed on the third day. In the event of rupture of the uterus with the presenting part low in the birth canal, extraction of the fetus is definitely contraindicated. Although vaginal delivery may in rare cases save the fetus, it enlarges the tear, increases hemorrhage, wastes valuable time and markedly lessens the patient's chance for recovery. If rupture of the lower uterine segment is minimal and known to be incomplete and nonseptic, and hemorrhage into the broad ligament and parametrium is not great, rupture may be repaired from below. If there is doubt about complete control of hemorrhage, the abdomen should be opened at once. Tamponade may at times be satisfactory but it is not advised.

In almost every case transfusion spells the difference between life and death. Less than 1,000 cc. is futile and it may be that 3,000 cc. of blood or more will be required. The administration of plasma is not recommended because of the danger of subsequent hepatitis. If plasma is used, it should be only as a stopgap and it must be irradiated. There are no oxygen carriers in plasma. If, as is advised, 1,000 cc. of compatible blood are available on every delivery floor, this will tide the patient over until more is obtained. It may be wise to make use of more than one venous portal for transfusion. Femoral veins are practical avenues for transfusion of blood and much better than the time-consuming and often futile cutdown upon collapsed veins elsewhere. A large bore needle should be used for blood is often needed quickly.

The immediate cause of death in rupture of the uterus is hemorrhage and shock. Later causes include infections such as peritonitis, bronchopneumonia and bacteremia. The prognosis in many cases depends upon the manner in which labor was managed prior to the rupture. If intrapartum infection or gross contamination has occurred, the prognosis is worse.

Lower nephron nephrosis probably occurred. Anuria following traumatic shock is almost sufficient to make the diagnosis; yet it is clear that the patient died of rupture of the uterus.

Case VII. The patient was a Negress, thirty-seven years old, para 1, who had had a cesarean section six years previously apparently for cephalopelvic disproportion. The type of section was not known but thrombophlebitis and wound infection followed the operation. Her prenatal course was essentially uneventful and she was informed that an elective section was planned.

About six weeks prior to term she entered the hospital after having labor pains for three hours. On examination the fetus presented by the vertex and the fetal heart was heard. The uterus was tonic but the patient appeared to be in good general condition. The operating room was ordered. While the staff were scrubbing, the uterus suddenly relaxed and contractions ceased. The patient went into shock. For this reason operation was deferred and she died one and a half hours later with the fetus undelivered. The patient had received 250 cc. of plasma and 700 cc. of glucose solution intravenously but no blood.

Autopsy showed complete separation of her previous cesarean section scar in the upper segment with extrusion of the fetus and placenta into the peritoneal cavity.

Questions. (1) What are the symptoms and signs of rupture of the uterus due to separation of a section scar? (2) Is rupture of the uterus due to separation of a previous section scar as serious as other forms? (3) Should the dictum "Once a cesarean, always a cesarean" be followed? (4) What predisposes scars of this type to rupture? (5) Should myomectomy scars be considered in the same light as cesarean section scars? (6) Should operation be deferred until shock has been combated by blood replacement? What if blood is not immediately avail-

able? Is the operative procedure any different in this type?

Comments. The symptoms and signs of rupture of the uterus due to separation of a classical cesarean section scar may vary greatly. Many of these cases give rise to a confusing group of symptoms and signs and often do not resemble the usual picture of rupture of the uterus as it is seen in obstructed labor. Occasionally when a repeat cesarean section is performed early in labor, one may note partial separation of the old scar with bulging of the membranes through it. Such patients may show few symptoms or signs because of the absence of any considerable hemorrhage. Rupture usually occurs during labor but may occur during pregnancy. Slight pain may persist between uterine contractions and on lower abdominal palpation one may demonstrate tenderness and peritoneal rebound pain; however, other than for these symptoms and signs the case may not differ from a normal early labor. If, however, the placenta is implanted beneath the old classical scar, the clinical picture will be more severe and the prognosis less favorable. Here rupture may occur in the third trimester of pregnancy due to progressive weakening of the scar, or in early labor. When rupture occurs, intra-abdominal hemorrhage may be severe and give rise to the symptoms of acute anemia and hematoperitoneum. The clinical picture associated with rupture of the uterus due to separation of a previous cesarean section scar may be extreme when separation is complete and the fetus with or without the placenta has been expelled into the abdominal cavity. Such ruptures occur during labor and are accompanied with sudden, sharp abdominal pain, shock and cessation of uterine contractions. Examination will disclose shock and evidence of acute anemia and often the fetus may be palpated outside the uterus which is reduced to a small, hard lower abdominal mass. The abdomen may be rigid and tender but with great diastasis recti it will be soft and the fetal parts may be easily identified. Fetal heart tones generally disappear. Vaginal bleeding may occur but is generally not severe. Symptoms may be lessened if part of the fetus held in the ruptured scar acts as a hemostatic.

Rupture of a lower segment cesarean section scar is infrequent as compared with rupture of the upper segment scar but may occur whether the placenta is implanted beneath the scar or not. Rupture may occur during the third trimester of pregnancy or in labor giving rise to an incomplete tear with hemorrhage beneath the bladder and into the broad ligament. The clinical picture is one of sudden, severe lower abdominal pain and some degree of acute anemia and shock. Examination will disclose a tender, rigid lower abdomen and the fetal heart may or may not be heard. Vaginal bleeding is generally not marked.

Whenever the symptoms and physical findings of a complication during pregnancy suggest the diagnosis of premature separation of the placenta and the patient has previously had cesarean section, one should suspect spontaneous rupture of the uterus. In doubtful cases it would be better to operate rather than to subject the patient to the conservative treatment of premature separation of the placenta with use of pituitrin. This type of rupture is not as serious as other forms. The prognosis is better because of the diminished vascularity in the region of the ruptured scar, the general occurrence of separation before rupture of the membranes and thus lessened infection and, finally, because anticipation leads to more prompt recognition.

Because of the ever present danger of rupture of the uterus from separation of a cesarean section scar during labor, many rigidly follow the dictum "Once a cesarean, always a cesarean." This leads to a steadily increasing number of cesarean sections with increased risk in secondary operation. There is good evidence to show that a certain percentage of patients who have had previous cesarean sections may be allowed to deliver vaginally. Many obstetricians are of the opinion that a carefully supervised trial labor is reasonably safe if the indication for the previous cesarean section is not present, the previous postoperative course normal and a lower segment operation had been performed. If labor has begun and satisfactory progress is made, careful observation and pelvic delivery aided by forceps is the treatment of choice. In arriving at a decision whether to do elective section before term or to await the onset of labor, the following factors must be weighed: *Type of previous cesarean section.* The scar following the classical operation is more likely to yield than that following the lower segment operation. A vertical incision in the lower segment is likely to give rise to a weaker scar than

the transverse incision because of the frequent inclusion of part of the upper segment in its upper end. When rupture occurs after the lower segment operation with vertical incision, it can generally be demonstrated that the upper end of the scar yielded first. *Previous postoperative morbidity.* If infection of the uterine incision has occurred in a previous section, firm healing of the scar is interfered with and a weaker scar results. Even though a febrile puerperium cannot be shown to be due to uterine infection, the existence of a weak scar should be assumed. *Previous infravaginal delivery.* If all previous deliveries, one or more, have been by cesarean section so that no preparations of the birth canal has ever occurred, the strain on the uterine scar during the second stage of labor is increased.

It would appear that there is little reason for cesarean section in the case of a multipara who has had at least one spontaneous delivery of a normal-sized living child without protracted labor, who has also had cesarean section with transverse incision without postoperative morbidity and in whom the indication for previous section or any new indication is not present. It is not safe, however, under any circumstances to risk infravaginal delivery after previous cesarean section unless the patient is carefully observed for signs of uterine rupture during her entire labor in an institution where facilities for immediate operation and blood transfusion are available.

A previous myomectomy may cause a scar similar to the cesarean section scar and the possibility of spontaneous rupture of the uterus is in some respects similar. The risk of rupture is definite if incision had been made deep into the uterine cavity, if the wound had not been sutured with care and if postoperative morbidity occurred. In a case in which the aforementioned are present, an elective cesarean section to prevent rupture of the uterus should be performed. It would be wise for the gynecologist who performs a myomectomy on a patient in the child-bearing age to record detailed data on the patient's chart with his opinion as to whether cesarean section is advisable in future pregnancies.

Delay of operation due to failure to secure compatible blood will generally result in death. *Although it is always well to combat shock prior to operation, delay in operating for rupture of the uterus is more dangerous than failure to give adequate amounts of blood.* When laparotomy is performed, excision of the old scar and resuture may be sufficient and is preferred. If the uterine laceration is large, irregular and ragged, as is the case usually with complete tears of the uterus, hysterectomy should be performed.

Case VIII. The patient was a thirty-six year old white multipara who had five children previously within a relatively short time. Her blood pressure was moderately high during the latter part of pregnancy, ranging between 140/80 and 158/70. Her membranes ruptured a week before admission to the hospital and she entered in labor. The baby appeared large and there was no engagement of the vertex. After an active labor of nine hours the patient suddenly went into shock. There was no bleeding. A diagnosis of rupture of the uterus was made immediately. During laparotomy the body of the fetus was in the abdominal cavity and a hydrocephalic head in the uterine cavity. The tear extended into the left broad ligament. Hysterectomy was performed and a 500 cc. transfusion was given during the course of the operation. An ileus and signs of peritonitis developed on the second day postoperatively and the patient died with cardiorespiratory complications on the fifth day.

Questions. (1) What is the usual site of the laceration in rupture of the uterus? (2) What is the pathogenesis in obstructive dystocia? (3) What is the best treatment for this condition? What signs indicate imminent rupture? What can be done when they occur? (4) Did this patient receive enough blood?

Comments. The lower uterine segment is the site of laceration in practically every case of spontaneous and traumatic rupture. Separation of upper segment scars resulting from previous cesarean section or myomectomy is the exception. Lateral longitudinal rupture of the lower segment with bleeding into the broad ligament is the most common lesion. Transverse rupture of the anterior lower segment may also occur with occasional injury to the bladder causing hematuria.

The pathogenesis of spontaneous rupture of the uterus is well known and represents an accentuation of the changes taking place in the uterus during a normal labor. During labor the uterus is divided into an upper, thick, well contracted segment and a lower, thinner, more relaxed segment. As labor progresses the con-

striction ring which normally demarcates these two segments of the uterus rises. Any abnormality in the passage or passenger which leads to difficulty in the expulsion of the fetus may cause excessive thinning out and stretching of the lower uterine segment with the production of a high retraction ring. Continued contractions of the uterus may ultimately result in rupture of the weakened lower segment, especially if some portion of the lower segment is caught between the presenting part and the pelvic girdle. The usual examples of this type of spontaneous rupture of the uterus are neglected transverse presentation and unrecognized, marked cephalopelvic disproportion as may occur in severely contracted pelves or with hydrocephalus. In the latter type the anterior lip of the cervix may be caught between the vertex of the baby and the pubis and aid in spontaneous rupture.

The best treatment is the prevention and recognition of obstructive dystocia and impending rupture. Adequate prophylaxis involves knowledge of the fundamentals of obstetrics. When dystocia is due to transverse presentation or frank hydrocephalus, the diagnosis should present no difficulties. Minor degrees of cephalopelvic disproportion may not be apparent but the diagnosis of pelvic contraction may be made by well accepted methods.

The association of obesity and the pendulous abdomen with deviation of the parturient axis as a predisposing cause of rupture is clear yet not well appreciated. Inquiry into the type of previous operation for retroversion should always be made. When fixation rather than suspension of the uterus has been done, the cervix may be displaced toward the promontory of the sacrum. Labor may cause excessive thinning of the anterior lower segment and rupture. One should recognize the importance of previous deep laceration of the cervix, repair, amputation or even cauterization. For the same reason, previous breech extraction or forceps delivery may play an important part. The most valuable part of the antepartum history of any multipara is the detailed record of her previous delivery. All the historical data should be given due weight if the diagnosis of rupture of the uterus is under consideration.

Rupture is imminent when the lower segment is extremely sensitive to pressure and the upper segment no longer contracts rhythmically but remains tetanically contracted. The retraction is more readily palpated. The pulse rate is accelerated, its volume less, and the patient appears anxious and apprehensive. The recognition of impending rupture calls for immediate treatment. Tetanic contractions may be largely controlled by the administration of ether or chloroform while preparations for delivery are being made. If the vaginal route for delivery is decided upon, as it occasionally may be, any operative procedure must be done with the utmost gentleness and care. Internal version is absolutely contraindicated. No attempt should be made to dislodge the presenting part or to thrust the fetus upward as these procedures will probably result in rupture of the excessively thinned-out lower segment. If forceps are applied to the vertex, the blades must be introduced carefully and if slight trial traction fails to bring about advance of the head, no further force must be used. If conditions permit, perforation of the head is preferable when forceps application delivery cannot be effected with the aforementioned precautions. If laparotomy is decided upon because of absolute pelvic contraction, pelvic tumor or in the interest of the baby, hysterectomy may be necessary.

This patient did not receive enough blood. The role of anemia in aiding the development of puerperal infection is well recognized, and perhaps this patient might not have died of infection if she had been given more than 500 cc. of blood.

Case IX. The patient was a thirty-four year old female, gravida VII, para VI, who was admitted to the hospital at term with the history of membranes ruptured for six hours; there were mild irregular uterine contractions. The fetal heart was heard. Ten hours after admission the pains were occurring every three to five minutes and were strong. At this time some doubt as to the presentation arose and the patient was examined vaginally when a transverse presentation was noted. The cervix was dilated about 8 cm.

Under nitrous oxide anesthesia an internal version and extraction of a living fetus were performed. Moderate hemorrhage followed delivery, with abdominal pain and shock. Treatment consisted of vaginal packing and administration of oxygen and plasma. Compatible blood arrived after the patient's death two hours after delivery. Post-mortem

examination disclosed a large complete laceration in the right lower segment with hematoperitoneum.

Questions. (1) What is the frequency of traumatic rupture? What operative procedure is the most frequent cause? (2) Is nitrous oxide the proper anesthetic for internal version? (3) How could this fatal accident have been prevented? (4) What are other causes of traumatic rupture? Is the diagnosis missed more often in this group that in spontaneous rupture?

Comments. Traumatic rupture of the uterus is more common than spontaneous rupture. In a recent study of sixty-four deaths in Brooklyn resulting from rupture of the uterus thirty-seven were of traumatic origin. *Internal version is by far the most common cause;* twenty of the thirty-seven traumatic ruptures were caused by it. Transverse presentation was discovered late. When abdominal and rectal palpation do not clearly indicate presentation, there should be no delay in vaginal examination, consultation or roentgenography. No patient should be permitted to continue long in labor with the presentation unknown. Impaction will occur and make any operative procedure more difficult and hazardous.

Internal version performed many hours after rupture of the membranes is fraught with great danger. It should be done soon after rupture of the membranes under deep ether or perhaps chloroform anesthesia, but not nitrous oxide or spinal anesthesia in any form. Uterine as well as general relaxation must be secured and version performed without undue haste. Version is contraindicated in transverse presentation after many hours of rupture of the membranes and impaction of the fetus into the pelvis. Here cesarean section with hysterectomy or a destructive operation, although both are attended with great danger, have a lesser risk. It is unwise to attempt version when a presenting part is well engaged and the membranes have been ruptured for some time since molding of the uterus about the fetus will generally prevent upward dislodgment of the head without rupture of the uterus. When internal version has been successful yet the cervix is not fully dilated, the patient should be permitted to come out of the anesthetic and continue in labor. Extraction through an incompletely dilated cervix invites disaster. Internal version after failed forceps is also especially hazardous.

Traumatic rupture as a rule is the result of an operative procedure like internal version, breech extraction, forceps rotation, extraction through a poorly dilated cervix or mutilating operations upon the fetus. It is in this group of cases that diagnosis is most often missed. The clinical picture of shock and persistent hemorrhage after delivery of the fetus is assumed to be due to trauma and anesthesia, particularly when the patient's condition was poor prior to delivery. Oxytocics are given, minor cervical lacerations are repaired and intravenous dextrose, blood plasma or blood may be administered but the possibility of rupture of the uterus is not considered. The true diagnosis is made only after exploration of the uterus which should include examination of the anterior wall. If rupture is complete, intestines or omentum may be palpated. If incomplete, the site of the hematoma may be recognized. *The uterus should be explored in every case when shock and persistent bleeding follow a major operative procedure.* It must be borne in mind, however, that the inexpert may fail in diagnosis even after exploration of the uterus. A complete change of mask, gloves, gown and sterile set-up is, of course, necessary.

Case x. The patient was a thirty-four year old multipara who was admitted to the hospital in active labor at term. After twelve hours of labor forceps delivery was attempted but this proved to be difficult for the operator. The fetus was stillborn. The placenta was retained. After twenty-five minutes suprapubic manipulation failed to express the placenta and bleeding continued. An attempt was then made to remove the placenta manually but this also failed. The placenta was finally expressed from above forty minutes later.

The patient went into shock and was given 1,000 cc. of 5 per cent glucose and 250 cc. of plasma intravenously. When seen by a consultant five hours after delivery the uterus was on the right and well contracted and the abdomen was rigid and tender. A diagnosis of rupture of the uterus was made but the consultant thought that the shock was too severe to permit operation. The patient was given 500 cc. of plasma and 1,400 cc. of whole blood. However, within two hours the pulse was still barely palpable.

Operation was performed. A rupture of the uterus was found extending from the left side of the cervix to the left round ligament. A

loop of intestine was found stripped of its mesentery and perforated. Hysterectomy was performed. Due to the poor condition of the patient resection of the intestine was not attempted. The perforated loop was brought outside the abdomen. The patient failed to react and died three hours after operation.

Questions. (1) What was the cause of rupture in this case? What caused perforation of the intestine and stripping of its mesentery? (2) Was treatment adequate?

Comments. Rupture of the uterus probably occurred during the forceps delivery. In attempting to extract the placenta manually the operator probably put his hand through the tear and traumatized the intestines, failing to identify the placenta since it was still retained.

Treatment was faulty. No one should apply forceps unless he is reasonably sure that the fetus can be delivered by this method without great trauma. There was five hours' delay before the consultant saw the patient. As indicated elsewhere, after early diagnosis the treatment must include immediate massive blood replacement and rapid hysterectomy. *Shock deterred the consultant, yet it should not have for the risk of death grows with procrastination.*

CASE XI. The patient was a forty year old markedly obese female who had previously been delivered of six babies, each averaging 9 to 10 pounds in weight. She was admitted to the hospital at term in active labor, On examination a large fetus was found in a left occipitoposterior position. The fetal heart was heard. After thirty-seven hours of labor with the membranes ruptured for thirty hours the head was delivered spontaneously. The shoulders became impacted and could not be delivered. The patient was anesthetized with ether and by a combination of strong fundal pressure and traction the shoulders were finally delivered at the end of one hour. The fetus was macerated and weighed about 11½ pounds. No uterine contractions had been noted following delivery of the head. The third stage of labor appeared normal. The patient was put to bed in fair condition. Shortly afterward she complained of pain in the lower abdomen. On the next day a rise in temperature to 101°F and a rise in pulse to 120 developed, with distention and tenderness throughout the abdomen. A diagnosis of severe post-partum infection was made. She rapidly became worse and died on the third day of an overwhelming infection. Autopsy showed peritonitis as a result of a transverse rupture in the lower uterine segment.

Comments. It appears that the trauma incurred during delivery of the impacted shoulders while under ether anesthesia was responsible for the tear in the uterus. Long labor and a large fetus were responsible for excessive thinning out of the lower segment. It is remarkable that uterine rupture does not follow fundal pressure more often. It would seem that the marked thinning out and weakening that occasionally occurs in the lower segment would predispose it to traumatic rupture from the combined force of strong fundal pressure and the forces of labor.

SUMMARY

1. Rupture of the uterus during pregnancy or labor is the most serious obstetric complication. If untreated its mortality approaches 100 per cent for the mother and undelivered fetus.

2. The obese multipara with a pendulous abdomen and scarring of the cervix is predisposed to rupture of the uterus.

3. No patient should be permitted to continue long in labor with the presentation unknown. Obstructive dystocia from malpresentation may cause spontaneous rupture of the uterus.

4. When pituitrin is used for the treatment of uterine inertia, the intravenous drip method is advised if certain contraindications are not present.

5. The symptoms and signs of rupture of the uterus due to separation of a cesarean section scar may vary greatly from the usual picture. In an occasional instance the dictum "Once a cesarean, always a cesarean" may be violated.

6. Internal version is by far the most common cause of rupture of the uterus. It is a dangerous procedure. When indicated certain prerequisites must be met.

7. The diagnosis would be made more frequently if it were thought of; shock during labor is significant.

8. The uterus should be explored in every case in which shock and persistent bleeding follow a major vaginal operative procedure.

9. The cardinal principles of good treatment are massive transfusion and immediate operation. Shock is no contraindication to operation.

Original Articles

PLACENTAL BARRIER IN CARBON MONOXIDE, BARBITURATE AND RADIUM POISONING*

SOME ORIGINAL OBSERVATIONS IN HUMANS

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MEDICAL examiners in their investigations of homicides, suicides, various casualties and poisonings often have the opportunity of seeing and interpreting lesions not accessible to hospital pathologists and other physicians. Sometimes important information may be encountered which, while not of direct importance to the medicolegal aspect of the case, may be of considerable use in other branches of medicine.

During the last few years certain observations have been made in the Office of the Medical Examiner of Essex County, Newark, New Jersey, as to what will and what will not cross the human placental barrier and enter the fetal circulation. These observations raise some important and startling questions which may stimulate gainful research by others.

PLACENTAL BARRIER IN CARBON MONOXIDE POISONING

One might expect that gases because of their easy diffusibility would all pass the placental barrier. This, however, is not true in the case of carbon monoxide. We have recently performed autopsies on two pregnant women who died from carbon monoxide. One was a suicide with illuminating gas; the other was overcome by carbon monoxide in a tenement house fire and was badly burned. The blood of the mothers had the typical cherry red color characteristic of carbon monoxide asphyxiation and revealed high saturations of carboxyhemoglobin. The blood of the fetuses, on the other hand, was dark in color and entirely negative for carboxyhemoglobin. These observations prove that carbon monoxide does not cross the placental barrier from mother to fetus.

By analogy, since carbon monoxide becomes rapidly fixed in the red blood cells as carboxyhemoglobin, we have further indicated that there is no transfer of red blood cells across the intact placental barrier. This latter observation is important because of the inherence of blood groups and Rh factors in the red blood cell and the currently unsettled question of iso-immunization of the pregnant woman by the red blood cells of her fetus.

It is timely because of the typically enormous and confused work of the Rh investigators, many of whom *by assumption* have staunchly maintained the placental transfer of red blood cells from fetus to mother in order to suit their various theories.

Case Reports

Suicide Using Illuminating Gas, Nine Months' Gestation. The deceased, aged twenty-six, who was nine months' pregnant and about to deliver, committed suicide using illuminating gas, killing her five and a half year old son at the same time. She was suffering from a psychosis of pregnancy and had had frequent family quarrels.

She was found by her husband who came home about 5:30 A.M. He found both bodies

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fully dressed lying on a bed, with a rubber tube leading from the stove in the kitchen into the bedroom and the room full of gas. Both bodies were cold and stiff and had been dead about nine hours. The mother was dressed in a black dress and the boy in a clean sweater, pants and shoes.

Autopsy twelve hours after death showed pink lividity over back of body fading on pressure. There was cherry red fluid blood in right side of the heart and cherry red color to musculature and all blood-containing organs. There was no chronic disease and no alcohol was found. The uterus contained a well preserved male fetus 18½ inches in length (full term) showing no maceration or decomposition. We were impressed by the cyanotic, bluish appearance of the fetus and its dark red blood as compared to the bright red blood of the mother, and decided to analyze blood of both mother and fetus. The placenta and membranes were normal. As there were no signs of putrefaction in the fetus and the suicide note stated that the woman hoped the gas would not bring on childbirth, it is assumed that the child was alive at the beginning of the suicide.

Toxicologic examination of the blood from the right side of the heart of the mother and fetus revealed the following: The mother's blood (cherry red) showed carbon monoxide hemoglobin saturation 88 per cent (Van Slyke); chemical and spectographic examinations of the blood of the full term fetus (dark red) were negative for carboxyhemoglobin.

Autopsy on the five and a half year old child showed typical carbon monoxide asphyxiation.

Carbon Monoxide Asphyxiation, Conflagration, Five Months' Gestation. The deceased, aged thirty-nine, five months' pregnant, was caught trying to get to the roof with her one and a half year old child and a fourteen year old niece in a tenement house fire. All three bodies were badly charred.

Autopsy two hours after death showed that the woman's feet were burned off as were her clothes. Her thigh bones were exposed, with cooked muscles showing. The top of her skull was bare, with bursting fracture due to heat. The body was in a pugilistic attitude; the abdomen was split open by the fire, with pregnant uterus extruding through the opening. The uterus on opening contained a female fetus 9 inches in length (beginning of the fifth month of gestation). The fetus was not macerated; the membranes were intact and the body cyanotic.

The mother's blood was cherry red, with bright red color to most blood-containing viscera. Blood of the fetus was dark red with viscera cyanotic. Toxicologic examination of the blood from the right side of the heart of the mother and fetus revealed the following: The mother's blood (cherry red) showed carbon monoxide hemoglobin saturation 48 per cent (Van Slyke); chemical and spectographic examinations of the blood of the five-month fetus were negative for carboxyhemoglobin.

Comment

These cases show that despite lethal concentrations of carboxyhemoglobin in the blood of the mothers, no trace of carbon monoxide could be found in the fetuses. It has been repeatedly shown that the human placental barrier is permeable to gases as well as to other innumerable substances. These include many different drugs, toxins, antitoxins, antibiotics, dyes, viruses and even certain colloids. As a rule it may be stated that almost any substance can cross the placental barrier if it is in solution or in gaseous form. Particulate matter may pass if its molecular size is not too large to be caught in the barrier. Moreover, the placenta is capable of breaking down oversized molecules into simpler forms which are then capable of being absorbed into the fetal circulation.

From such observations there is every reason to believe that the placental barrier is permeable to a gas as simple in structure and as low in molecular size as carbon monoxide. The failure of carbon monoxide to cross the barrier is obviously then not because of its impermeability. The marked affinity between carbon monoxide and the hemoglobin of the red blood cells to form carboxyhemoglobin is well known. When carbon monoxide is inhaled, the gas rapidly diffuses through the plasma and into the red blood cell where it is rapidly fixed as carboxyhemoglobin. This process is so rapid and complete that in the case of the pregnant woman by the time the blood, exposed in the capillary bed of the lungs, has reached the placenta there is little or no gas left in the mother's plasma to diffuse through the placental barrier into the fetal circulation. Since the death of the mother occurs long before her red blood cells are completely saturated

with carboxyhemoglobin, any accumulation of diffusible carbon monoxide gas in the mother's plasma is never possible.

Obviously, if the red blood cells of the mother were capable of traversing the placental barrier, we should expect to find some carbon monoxide in the fetal vascular system. Since this is not the case, we can only conclude that the red blood cells of both mother and fetus because of their relatively large size do not cross the intact placental barrier. Yet many of the Rh investigators infer that the placenta as an imperfect organ permits at various times the leaking of small numbers of fetal red blood cells into the maternal circulation. Only minute quantities of fetal Rh-positive red cells are needed, it is claimed, to iso-immunize the Rh-negative mother. Some maintain that this leaking occurs during the latter half of pregnancy (when the fetus literally kicks its red blood cells across the barrier). Others maintain that it occurs only during the rigors of labor and delivery.

To support their contentions further that leaks do occur from fetus to mother they claim that placental permeability increases toward the end of pregnancy due to (1) a general thinning of the entire barrier from distention and stretching, (2) a reduction in trophoblastic endothelium and (3) increased pressure in the fetal circulation over that in the maternal sinuses.

In addition recent reports, resulting from studies of placentas after normal deliveries and after deliveries of erythroblastic fetuses in the latter half of pregnancy, have claimed to confirm the transplacental transfer of red blood cells between mother and fetus. In these reports erosions and necrosis of placental villi with evidences of old and recent clot formation within the villi are described. These findings are supposed to represent conclusive evidence that an interchange of maternal and fetal blood has occurred across the intact placenta. We believe that such findings are those of normal metamorphosis in the dying placenta as it nears term and that they in no way conclusively demonstrate the intermingling of bloods. Described also in these reports are numerous microscopic breaks in the barrier associated with hemorrhage from the fetal circulation into the maternal intervillous spaces. We wish to emphasize, however, that these observations are in placentas after separation and delivery and by no means prove that there has been an actual interchange of red blood cells between mother and fetus.

Our observations as heretofore described have been on intact placentas which were near term. They have the advantage of being physiologic as well as structural observations. They indicate that there is no barrier break to red blood cells across the intact placenta. We are of the opinion, moreover, that there is even less likelihood of an interchange of maternal and fetal cells during separation due to the positive cleaving pressure of the out-pouring blood from the uterine wall. Our observations are probably to date the most striking positive evidence in the human against the transplacental transfer of red blood cells between mother and fetus which has been conveniently assumed by the Rh investigators but in no way conclusively demonstrated.

PLACENTAL BARRIER IN BARBITURATE POISONING

Based largely on clinical evidence in humans and animal experimentation, it has been known that the placental barrier is permeable to the barbiturate group. We are presenting a case of a suicide of a woman pregnant nine months by barbiturate poisoning which illustrates by organ analysis the placental transfer in the *human*. More than this, the toxicologic data reveal that the barbiturates accumulate in the fetus to a level almost twice that of the mother.

Medical examiners are impressed by the high incidence of asphyxiated newborn babies from mothers dosed with barbiturates, paraldehyde and other volatile anesthetics. It is our opinion that to produce an appreciable effect on the parturient mother by the use of these agents toward the relief of her anxiety and pain is apt to subject the fetus to dangerous, often toxic amounts.

Case Report

Suicide by Barbiturate Poisoning, Nine Months' Gestation. The deceased, aged twenty-three, took an unknown number of sleeping tablets at about 10 P.M. She was found twelve hours later in a comatose condition with a suicide note in her room. She was admitted to the hospital where a gastric lavage was performed. The urine was saved and a quick analysis showed the presence of barbituric esters. The woman died in coma fifty hours after ingesting the tablets.

Autopsy showed only terminal pulmonary edema and a full term pregnancy. The fetus was 19 inches in length and weighed 6½ pounds. There was a center of ossification in lower end of femur ¼ inch in diameter (full term). The fetus was not macerated. There were multiple petechial hemorrhages in thymus, visceral pleura and visceral pericardium (denoting intrauterine asphyxiation).

Toxicologic examination of organs of mother and fetus showed the following: Mother: weight of brain 150 gm., barbituric acid esters 2.25 mg., weight of liver, kidneys and spleen 70 gm., barbituric acid esters 2.50 mg.; fetus: weight of brain 150 gm., barbituric acid esters 4.00 mg., weight of liver, kidneys and spleen 70 gm., barbituric acid esters 3.75 mg.

Comment

The significantly higher percentage of the barbiturates in the brain, liver, kidneys and spleen of the fetus as compared to the mother is, of course, due to slower and less efficient detoxification and excretory mechanisms of the fetus *in utero*. Elimination of the barbiturates depends upon the ability of the liver to degrade and the kidneys to excrete them. These functions are greatly curtailed in the fetus. Certainly, therefore, one cannot casually minimize the toxic effects of the barbiturates on the fetus.

Yet the barbiturates have been copiously used by many obstetricians during labor. They are usually employed with the objective of rendering the patient tranquil and drowsy so that she will sleep between pains and not remember the ordeal, but nevertheless remain sufficiently conscious to assist in the delivery. In order to achieve such a state in the mother the dosage is necessarily usually high. The respiratory centers of the newborn are often as a consequence so depressed that in some series of cases approximately one-third of newborns fail to breathe initially at birth, requiring in many instances potent forms of respiratory stimulation. In contrast, in series in which no barbiturates or other sedatives are used less than 2 per cent of newborns fail to breathe at birth. This latter figure would seem to be the normal ideal which too often is a far cry from harassed and hard-pressed obstetricians.

Moreover, a surprising number of obstetricians not content in using barbiturates alone combine them with morphine, scopolamine, paraldehyde and volatile anesthetics, all of which not only cross the placental barrier, but are apt to be exceedingly toxic to the fetus. In reference to paraldehyde we have had for some time the distinct impression that its use in obstetrics has increased the number of asphyxiated babies.

Other investigators believe that the large number of asphyxiated baties at birth is due to the low oxygen concentration entailed in nitrous oxide administration during the second stage of labor. There should be no need to mention the very profound effect that morphine has in depressing the respiratory center. We believe, therefore, that most if not all of the sedatives which are given via the oral, rectal, parenteral and inhalation routes tend to "pool" in the fetus as we have shown in the case of the barbiturates.

On the other hand, there is apparently no dangerous accumulation either in the mother or fetus when the appropriate anesthetics are administered to the parturient mother via the low caudal route. Physical and psychologic preparation for "natural childbirth" is currently receiving renewed interest. This method probably deserves more consideration than it will ever obtain.

PLACENTAL BARRIER IN POISONING BY RADIOACTIVE SUBSTANCES

Internal radium poisoning due to the harmful effects caused by the swallowing, inhalation or injection of radium, mesothorium or other "long-lived" radioactive substances was unproven until 1925 when the senior author and his co-workers reported deaths among watch dial painters formerly employed in a New Jersey plant. These girls while painting luminous dials pointed their brushes in their mouths and swallowed small amounts of radioactive luminous paint. In the original publication the symptoms, diagnosis, autopsy findings, microscopic pathology, toxicology and prevention were described for the first time. In 1929 and 1931 the senior author reported the occurrence of bone sarcomas in these original radioactive dial painters, this being the first recorded description of osteogenic sarcomas caused by radioactivity. Even at the present time these observations remain the only known exogenous factor that causes bone sarcomas in human beings.[2]

For the last twenty-five years we have been following up and studying radioactive human beings. This comprises many of the original dial painters (the famous New Jersey cases) who have died during this period and many who are still alive twenty-five to thirty years after they had stopped dial painting. It also includes a few chemists, physicists and other workers who have died as the result of undue amounts of radioactive substances in their bodies. At the present time we have records of forty deaths due to internal poisoning by radioactive substances, with autopsies performed in most of the cases. Jaw necrosis due to radiation osteitis and refractory pseudoaplastic anemias have caused twenty-three of these early deaths, the bodies containing usually the equivalent of 20 to 180 micrograms of radium at the time of death.

Osteogenic sarcoma caused fifteen deaths, most of them occurring eight to twenty years after exposure, the bodies containing the equivalent of from 1 to 20 micrograms of radium at the time of death. Carcinoma arising from the accessory sinuses of the head caused two deaths, both showing extensive radiation osteitis of the skull.

In addition during the last few years we have made over 170 examinations of recent dial painters working under modern plant hygiene to see that they do not accumulate dangerous amounts of radioactivity in their bodies.

The clinical data, roentgenograms, autopsy findings and examinations for radioactivity in these cases have been presented as a permanent historical exhibit at the American Museum of Atomic Energy, Oak Ridge Institute of Nuclear Studies, at the request of the Atomic Energy Commission.

DO CHILDREN OF RADIOACTIVE MOTHERS BECOME RADIOACTIVE?

During the height of the original investigations these early deaths were much publicized and the question arose whether the children of these dial painters might become radioactive with harmful effects. It was our opinion that gaseous emanations continuously circulating in the mother's blood arising from radioactive deposits in her body might pass the placental barrier and minute amounts of "short and long-lived" decay products might render the fetus radioactive.

Although a few children were examined by electroscopic methods with negative results, it was thought that our methods of detection at this time were not sensitive enough to prove this assumption actually.

Examination of Seventeen Children for Radioactivity. In 1939 more sensitive instruments were devised for the detection and measurement of radium in the human body and we decided to find as many children of the original New Jersey dial painters who had licked their brushes as was possible and examine them.

From 1939 to the present time we have examined seventeen of these children using methods devised by Robley D. Evans, Professor of Physics at the Massachusetts Institute of Technology.* Of the seventeen children of ten mothers examined, only one was born while the mother was still a dial painter; sixteen children were born two, three, four, five, six, seven, ten, eleven, twelve, fourteen and fifteen years after their mothers had stopped dial painting. Seven of these ten mothers are now dead from poisoning by radioactive substances ingested while licking brushes as they worked.

Methods of Examination. Two methods were used, namely, measurement of gamma rays coming from the body by means of the Evans gamma ray quantum-counter (a modified extremely sensitive Geiger counter) and measurement of the breath radon by quantitative, electrical methods.

Gamma ray measurements detect approximately 55 per cent of the total body radium in chronic radium poisoning by measuring the gamma rays from the decay products of radium B and C coming from fixed deposits in the body. Such measurements have only an ultimate sensitivity of about 0.2 microgram of radium. This, unfortunately, is slightly above the tolerance dose which has been set as 0.1 microgram for total body radium, and, therefore, is of no practical use in measuring subtolerance levels. However, if the patient's body by partially shielding the pick-up tube of the Geiger counter from cosmic and local gamma radiations causes readings to be below the background readings, rarely is there any appreciable body radioactivity present. This has been shown by cross-checks with the more sensitive breath radon tests. (Fig. 1.)

* We are greatly indebted to Dr. Evans for the construction of a special gamma ray quantum-counter, for the breath radon tests made on several children and their mothers, and for his advice and cooperation.

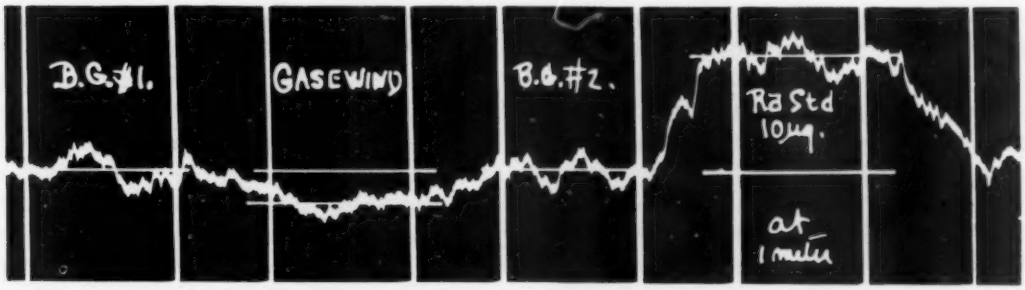

FIG. 1. Gamma ray measurements on one of the children; note that the readings on the child are below the adjacent backgrounds. Such a test is considered negative inasmuch as it shows no dangerous amounts of radioactivity in the child. This was confirmed by the more sensitive breath radon tests.

Breath radon tests detect approximately 45 per cent of the total body radium in chronic radium poisoning by measurement of the gas radon given off in the expired air. The total body radium therefore equals the sum of the gamma ray measurements and the breath radon tests. Breath radon tests measure as low as 0.01 microgram (0.1 micromicrocurie of radon per liter) which is twenty times more sensitive than most Geiger counters.

Results of Measurements on the Children. Gamma ray measurements were made in all seventeen children, fourteen of whom were considered definitely negative. The conditions of three of the children were considered suspicious after the gamma ray measurements and were rechecked with breath radon tests, with negative results.

We would have wished breath radon tests for all of these children but in the early observations such tests had not been perfected and were not accessible. Moreover, it was extremely difficult to get many of these children as their families were frightened and wanted to forget about the horrible deaths of their mothers.

Case Reports

CASE I. Q. McD., a radium dial painter for fifteen months in the period from 1917 to 1918, licked brushes. She bore a daughter while she was a dial painter and a son three years after she stopped doing that work. In 1928 she had jaw necrosis and pains in bones and left hip. Gamma electroscopic tests and tests of expiratory air by electroscopic methods of Schlundt showed the equivalent of 12 micrograms of radium in her body. At the age of thirty-four in 1929, eleven years after exposure, she died from osteogenic sarcoma of the left femur.

In 1939 the two children were examined. The daughter, aged nineteen, and the son, aged fifteen, were in good health. Gamma ray measurements showed readings below the backgrounds and the children were considered negative. No breath radon tests were made.

CASE II. A. S., a radium dial painter for three years from 1919 to 1921, licked brushes. A daughter was born six years after the mother stopped dial painting. In 1928 the mother had bone pains, jaw necrosis and anemia. Roentgenograms showed early osteogenic sarcoma of the pelvis. Gamma ray measurements and expiratory air tests made by electroscopic methods of Schlundt showed the equivalent of 6 micrograms of radium in her body. She died in 1930, nine years after exposure, at the age of twenty-seven from two primary osteogenic sarcomas, one in the pelvis and the other in the ethmoids.

In 1939 the daughter, aged twelve, in apparent good health, was examined. Gamma ray measurements showed readings below the backgrounds and the child was considered negative. No breath radon tests were made.

CASE III. R. S., a radium dial painter for three years from 1919 to 1922, licked brushes. A daughter was born to her ten years after she stopped dial painting. In 1922 she had considerable dental trouble and vague bone pains. Gamma ray measurements showed the equivalent of 2.8 micrograms of radium giving off gamma rays. No breath radon tests were made but if taken the total body radium would have measured approximately 5.1 micrograms. She died in 1944 at the age of forty-five, twenty-two years after exposure, from osteogenic sarcoma of femur.

In 1939 the daughter, aged seven, in apparent good health, was examined. Gamma ray measurements showed the equivalent of 0.12 microgram of radium in her body giving off gamma rays. This suspicious reading, which is

really below the sensitivity of the counter, was thought to be due to some unexplained fluctuations in the Geiger tube and another test was recommended. In 1944 she was again examined and since readings were below the backgrounds she was considered negative. However, to be sure, two breath radon samples with two samples of room air were taken. Evans reported, "The two breath samples contained no radon in excess of the 0.3 micromicrocurie of radon per liter contained in the room air samples . . . This means that the child probably harbors less than 0.01 microgram of radium."

Case IV. M. F., a radium dial painter for one year from 1917 to 1918, licked brushes. Two daughters were born to her six and twelve years, respectively, after she stopped dial painting. In 1939 she had vague bone pains. Gamma ray measurements showed the equivalent of 0.4 microgram of radium giving off gamma rays. No breath radon tests were made but if taken the total body radium should be around 0.73 microgram. The mother is alive and has moved to some other part of the country.

In 1939 the two daughters, aged fifteen and nine, were examined. Gamma ray measurements showed readings below the backgrounds and they were considered negative. No breath radon tests were made.

Case V. S. L., a radium dial painter for four years from 1919 to 1923, licked brushes. Four boys were born to her three, four, six and ten years, respectively, after she stopped dial painting. In 1933 at the age of thirty-five she died after an illness of several months, ten years after she stopped dial painting. Autopsy showed extensive ulcerative and necrotizing colitis of unknown etiology. Gamma ray measurements of bones showed the equivalent of 10 micrograms of radium in her skeleton. Her total body radium was estimated as around 18.2 micrograms.

In 1939 all four boys, aged thirteen, twelve, ten and six, were examined and all were in apparently good health. Gamma ray measurements showed all readings below the backgrounds and the children were considered negative.

Case VI. K., a radium dial painter for three years from 1917 to 1919, never licked brushes as she used a turpentine mixture of luminous paint. A son was born to her five years and two daughters were born eleven and fifteen years after she stopped dial painting. She was examined in 1939. Gamma ray measurements showed readings below the backgrounds and she was considered negative. She is at present alive and well.

In 1939 her three children, aged fifteen, nine and five, were examined. Gamma ray measurements showed readings below the backgrounds and they were considered negative. No breath radon tests were made. This is a good control case since the mother was exposed under the same factory conditions as the other workers except for the fact that she did not lick her brushes and swallow the paint. As would be expected, she showed no appreciable radioactivity.

Case VII. E. M., a radium dial painter for four years from 1918 to 1921, licked brushes. A boy was born to her two years after she stopped dial painting. In 1939 she was examined and was found to be in a fair state of health; there was some jaw necrosis. Gamma ray measurements showed the equivalent of 2 micrograms of radium giving off gamma radiations. No breath radon tests were made but if taken her total body radium would have measured approximately 3.6 micrograms. She is at present alive and in fair health.

In 1939 the son, aged sixteen and in good health, was examined. Gamma ray measurements showed readings below the backgrounds and were considered negative. No breath radon tests were made.

Case VIII. G. H., a radium dial painter for nine years from 1919 to 1928, licked brushes. A boy was born to her seven years after she stopped dial painting. She was examined, in 1939. At that time she was in bad physical condition, showing extensive radiation osteitis over skeleton with necrosis of jaws and temporal bones. Gamma ray measurements showed the equivalent of 3.7 micrograms of radium giving off gamma radiations. No breath radon tests were made but if taken her total body radium would have measured approximately 6.7 micrograms. She died shortly afterward, eleven years after exposure to radioactive luminous compounds, with necrosis of base of skull, epidural abscess and meningitis.

In 1940 the son, aged five, in apparent good health, was examined. Gamma ray measurements showed a very slight rise above backgrounds and a reexamination was advised. In

1944 the boy, aged nine, was again examined. Gamma ray measurements showed readings below the backgrounds and he was considered negative. Because of his previous suspicious gamma ray measurements, breath radon tests were taken. Evans reported, ". . . 0.3 micromicrocurie of radon per liter, which was the same as the room air samples. It is probable that this child would give less than 0.1 micromicrocurie of radon per liter and that therefore he contains less than 0.01 micrograms of radium."

Case IX. F. R., a radium dial painter for over one year from 1918 to 1919, licked brushes. She gave birth to a daughter fourteen years after her last exposure. She moved to California, where vague bone pains developed and she was treated for arthritis. She forgot all about her former occupation as a dial painter. In 1940 on a visit East her brother, a dentist, suggested that she might have radium poisoning. Gamma ray measurements showed the equivalent of 3.54 micrograms of radium giving off gamma radiations. No breath radon tests were made but if taken her total body radium would have measured approximately 6.4 micrograms. She returned West and soon afterward roentgenograms showed early osteogenic sarcoma of the left femur which was confirmed by biopsy. She died in 1945 at the age of forty-eight, twenty-six years after exposure to radium paint. Autopsy showed a large, ulcerating sarcoma of the left femur with metastasis to lungs. Further measurements are being made by Evans using alpha plates for quantitative autoradiographs.

In 1940 her daughter, aged seven, in good health, was examined. Gamma ray measurements showed readings below the backgrounds and she was considered negative. No breath radon tests were made.

Case X. H. G., a radium dial painter for three years from 1916 to 1919, licked brushes. A son was born to her four years after she stopped dial painting. She was in fine health until 1943 when she required considerable dental care. In 1948 she was brought by her dentist to a laboratory for examination. Gamma ray measurements showed the equivalent of 1.9 micrograms of radium giving off gamma radiations. Breath radon tests showed 25 micromicrocuries of radon per liter of expired air or the equivalent of 1.0 microgram of radium. The total body radium was estimated as 2.9 micrograms. Roentgenograms showed extensive destruction of maxillas and mandible, loss of most of the teeth, radiation osteitis in spine and white lines in radial epiphyses. Soon thereafter she developed persistent pain over the left mastoid and left side of head which was not relieved by any form of treatment. In 1949 at the age of forty-eight she died of epidermoid carcinoma arising in nasopharynx and invading temporal bone and base of skull, thirty years after exposue to radioactive substances. This is the second patient in our whole series of dial painters who has died from carcinoma of accessory sinuses of the head rather than from the usual osteogenic sarcoma.

In 1949 the son, aged twenty-six, in good health, showed gamma ray measurements below the background and was considered negative. Very accurate breath radon tests were made by Evans who reported, "The measurements of the breath samples showed 0.1 micromicrocuries of radon per liter. A breath sample and an air sample were paired according to the time they were taken and then run on two different instruments; a pair of breath and air on each. Then we measured the difference between the radon contents of the breath and the accompanying air samples. In both cases it was measured to be less than 0.1 micromicrocurie radon per liter. It would be safe to say that he has no appreciable body radium."

Comment

It is of importance to note the composition of the luminous paint used by these mothers when employed as dial painters in the original New Jersey plant during the years 1916 to 1923. At that time the paint consisted of crystalline zinc pyrosulphid mixed with various proportions of radium, mesothorium and radiothorium in order to obtain the desired amount of luminosity. Mesothorium in equilibrium with its radiothorium emits five alpha particles whereas radium emits only four. The alpha particles of mesothorium and its decay products have a greater velocity and penetration than those of radium and therefore are chemophysically and toxicologically more active. During this period the formula of the paint was frequently changed as far as its radioactive content was concerned and was kept a commercial secret. There is considerable evidence that the mesothorium had been at times as high as 80

per cent; and since it was not pure, it might have contained as high as 20 to 25 per cent radium. At other times the mesothorium might have been greatly reduced and the radium increased.

There is definite evidence that after 1925 the mesothorium was reduced to 20 to 25 per cent and finally eliminated in most luminous compounds, leaving radium as the only radioactive substance in the paint. In 1941 a tolerance dose for radium was established for the protection of workers in the dial-painting industries using radioactive substances. This was set as 0.1 of a microgram as total body radium, accumulation above which was regarded as potentially dangerous.[3] In establishing this tolerance dose the amounts of radium thought to produce disastrous results were put very low to prevent such a tragic recurrence of radium poisoning. It was based mainly on the amounts found in these original dial painters dying years after exposure. No attention was paid to mesothorium since its half decay period of 6.7 years allowed most of it to disappear, although in the reports of early cases mesothorium and radium were found during life and after death in many of the early cases by electroscopic methods.

The children whose cases were reported herein were examined for radium alone, as an accurate estimation of the gas thoron would have been extremely difficult at the time of their examinations and detected only by specially constructed newer atomic instruments not available at the time.

SUMMARY AND CONCLUSIONS

Carbon Monoxide Poisoning. Autopsies on two pregnant women who had succumbed to carbon monoxide asphyxiation have revealed that carbon monoxide does not cross the placental barrier into the fetal circulation due to its rapid and complete fixation within the red blood cells of the mother. This observation is probably the first that has been made in such an "unarranged human experiment." By analogy we believe that this is the most striking evidence to date in the human against the transplacental transfer of red blood cells between mother and fetus.

In the absence of convincing evidence to the contrary doubt is raised as to whether the present theories of Rh iso-immunization are partly or entirely false.

Barbiturate Poisoning. To our knowledge we have herein reported the first human case in which the placental transfer of the barbiturates has been demonstrated by quantitative organ analysis of the mother and her fetus in barbiturate poisoning. The toxicologic data reveal that the barbiturates accumulate in the fetus to a level almost twice that of the mother due to the slower and less efficient detoxication and excretory mechanisms of the fetus. By inference this "pooling" tendency in the fetus is probably the fate of most if not all of the sedatives which are given via the oral, rectal, parenteral and inhalation routes. Attention is thereby directed to the increased neonatal morbidity and mortality resulting from the use of such agents and routes during labor.

We have indicated that the present, generally accepted, widespread and indiscriminate use of the barbiturates and other sedatives during labor is indeed regrettable.

Radium Poisoning. Seventeen children of ten mothers, former luminous watch dial painters, have been examined for actual radium deposits in their bodies. All showed no appreciable amounts of radioactivity in excess of 0.01 microgram, which is considered to be comparable with the upper limits of normal radioactivity in the human body.

Although this does not prove that the gaseous emanations constantly present in the mother's blood do not cross the placental barrier and render the fetus radioactive, should they do so, radioactive deposits in the children would be too small ever to produce harmful results in the children or their descendants.

Gamma ray measurements were made in all seventeen children. The more sensitive breath radon tests were used on three children who were thought to show radioactivity as a result of the gamma ray measurements.

In view of the present interest in the biologic effects due to atomic energy, the mutations found experimentally in the overworked Drosophila fly and gold fish and the frightening predictions made by some on the future of the human race, we believe that these observations should be put on record as they represent the only data of their kind in existence at the present time.

Internal poisoning by the ingestion, inhalation or parenteral injections of long-lived radioactive substances in which permanent

radioactive deposits can be detected and measured during life and after death is not to be confused with the deleterious effects caused by undue, excessive, external exposure to x-rays, excessive amounts of radioactive material or to the explosion of atomic material. Such external exposures rarely render the individual radioactive unless radioactive material is inhaled or ingested, since the deleterious effects are mainly due to external, penetrative and non-accumulative radiations.

In contradistinction to the harmful effects of undue external exposure to various radiations, internal poisoning by radioactive substances has been characterized mainly by anemias of the pseudo-aplastic type (large doses), radiation osteitis, necrosis of the jaws and temporal bones, and osteogenic sarcomas since essentially all the retained radioactive substances are eventually stored in the bones.

If the portal of entry has been chiefly the respiratory tract, bronchiogenic carcinomas have occurred. In rare cases carcinoma of the nasal sinuses have been encountered in radioactive dial painters due to stimulative-destructive effects of radon in their expired air.

No effects on the generative organs have been noted and sterility and genetic mutations are not a problem.

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DELAYED SUTURE IN THE MANAGEMENT OF WOUNDS*

ANALYSIS OF 721 TRAUMATIC WOUNDS ILLUSTRATING THE INFLUENCE OF TIME INTERVAL IN WOUND REPAIR

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EXPERIMENTAL as well as clinical investigation during the past few years has contributed much to the present concept of wound repair. The influence of proteins and vitamin C on wound healing has been of particular fundamental significance. It is our desire to present still another factor, namely, time interval, which exerts a very vital influence on wound repair in those wounds in which surgical judgment dictates *delayed suture* rather than *primary suture.*

In discussing a subject concerned with delayed suture it is first of all essential that this surgical procedure be clearly defined. Especially is this true since many American surgeons[1–6] have used the term "secondary closure" which by strict definition in this connection is erroneous. Cutler pointed out, "It is not a secondarily closed wound, because it was never closed before. It is not delayed primary closure, because there has been no primary closure."[7]

It appears that the term delayed suture or delayed closure, as used by most British surgeons,[8–15] more clearly defines the procedure. There is no desire to indulge in a play of words but only to clarify the terminology in common use; thus when a wound is closed immediately following débridement, it is closed by primary suture and the wound is said to be primarily closed. However, when the wound is left open following débridement and closed later, it is naturally a delayed closure or the wound is said to be closed by delayed suture. No particular technic or method in accomplishing this delayed closure is implied.

The evolution to the present concept of delayed suture was slow and fraught with some confusion, little having been carried forward from experiences during the last war.[16–18] Several different formalities, technics or methods of closure were utilized, each having its ardent advocates. One of these, consisting of (1) preliminary inspection, (2) bacteriologic cultures of wound flora and (3) preliminary wet dressings, was used in World War I and has been described in detail by Pool.[16] Although this routine was used to some extent in World War II, *a noteworthy contribution to wound management has been the revelation that this procedure, or any part of it, is not only unnecessary but also actually detrimental to best results.*[19]

Preliminary inspection, dressing or even peeping as well as wet dressings are therefore discouraged unless there is some obvious evidence of infection. Even in instances of sepsis the initial dressings are better handled in the operating room. A revision of the wound to facilitate drainage or for the removal of a retained foreign body is frequently indicated. A fixed policy was adopted of leaving the initial dressing undisturbed until the patient arrived in the operating room. At that time the dressings were removed and an evaluation of the wounds was made on their gross appearance alone. As Lyons[20] has stated, "The gross surgical pathologic condition of a soft-parts wound gives more information than the routine bacteriologic study of that wound." Including those wounds which were obviously septic when the patient was first admitted, there were 111 or 15 per cent which were deemed unsuitable for immediate closure. These were accordingly given forty-eight to seventy-two hours or longer of wet dressings before closure was attempted. In the remaining 85 per cent delayed closure was effected immediately by whatever method seemed applicable including skin graft.

TIME INTERVAL

From an analysis of 721 traumatic wounds in which delayed suture was utilized it was learned that the time interval between the initial surgery (débridement) and delayed suture was the all important factor. Although several observa-

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tions have suggested the importance of time interval, a lack of general agreement and more or less vagueness has been apparent as to the optimum time interval. It appears that this analysis has established a definite optimum time interval during which all wounds left open in anticipation of delayed suture should be closed.

TABLE I
DEGREE OF SEVERITY

Slight	96
Moderate	450
Severe	175

The 721 wounds included in this investigation were those incurred by 360 consecutive, unselected battle casualties. Thus they were not all simple soft tissue wounds but included those complicated by compound fractures, nerve injuries, amputations and abdominal and thoracic injuries. For example, there were fifty-two patients in this series with one or more compound fractures, having a total of 122 wounds (more than two per patient). The policy was adopted of converting compound fractures into simple fractures as soon as it was possible to effect a closure. The technical problems involved in the reparative management of these injuries have been fully discussed by Hampton.[21]

It is to be noted (Table I) that most of the wounds were classified as moderately severe. All of these involved deep muscle and fascia. Table II gives the distribution of these wounds. From a glance at this table it becomes apparent that the extremities are the most vulnerable. Perhaps a more accurate statement is that they are the most frequently wounded, permitting survival. However, it became evident that it was not the severity of the wound or its location which determined the success, failure or degree of healing of a wound closed by delayed suture. Neither was it the method or routine followed in closing the wound. Assuming that the patient's primary surgery or débridement had been adequate, it became evident that *it was the time interval between his initial and reparative surgery which determined the results and degree of healing.* In fact, the time interval frequently dictated the technic or method used in effecting a delayed closure.

In wounds with a time interval of four to six days the tissues were found soft and pliable and could be approximated without tension; no undermining, wound trimming, or excision was necessary. (Fig. 1.) In this manner 138 or 19 per cent of the total wounds were closed. The high percentage of healing (97.4 per cent) in this group has not been attributed to the method of closure but rather to the ideal time interval.

TABLE II
DISTRIBUTION OF WOUNDS

Head and face	4	
Trunk including chest wall and flanks	81	
Buttocks	53	
Upper extremities, including shoulder and neck	206	
Thigh	221	583
Lower extremities	156	

Approximation of tissue during this time interval may be considered ideal because it occurs at the onset of the second or fibroplasia phase of normal wound repair.[22–24] During this phase fibroblasts begin proliferating and extending themselves into the delicate fibrin network of coagulum prepared during the first or lag phase of repair. At the same time capillary buds develop and become canalized and filled with blood. Soon the rapidly increasing fibroblasts supporting, as it were, their accompanying capillaries have occupied the remaining defect and continuity of tissue is again restored. Simultaneously with this phase of repair epithelial cells proliferate and if the margins are in apposition, they close the wound. Although in delayed suture some retardation in this normal sequence of repair may occur, this analysis indicates that very little is lost when approximation is accomplished early in this phase of fibroplasia.

In wounds with a time interval of seven days or longer it was found that the tissues had become fixed, with an inversion of the epidermis. (Fig. 2.) In these it was necessary to freshen or excise the wound edges and to undermine to a varying extent in order to accomplish a closure without undue tension. (Fig. 3.) In 489 wounds or 68 per cent of the total this procedure was followed. Only 86.7 per cent healing was obtained in this group.

In eighty-seven or 12 per cent of the wounds a method designated as excision *en masse* was utilized. This term implies that the entire wound including its base and the skin edges was excised. Although this procedure was applied by personal preference in some of the younger wounds, it was particularly advan-

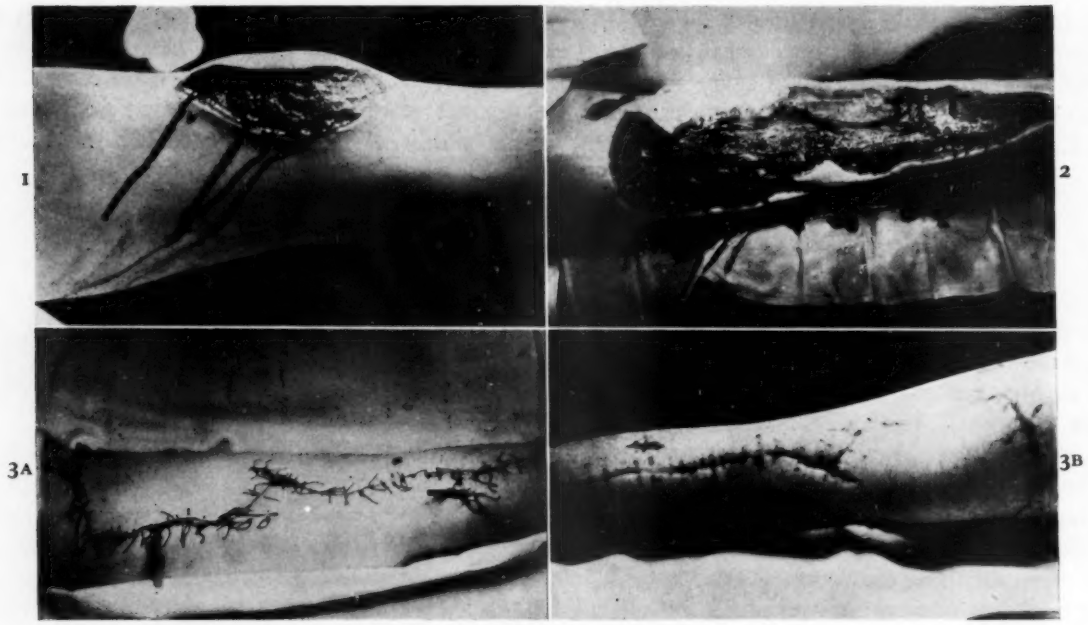


FIG. 1. Appearance of a wound at the ideal time interval.
FIG. 2. Wound with a time interval of sixteen days; the tissue has become fixed, with an inversion of the epidermis.
FIG. 3. A, same wound as illustrated in Figure 2; excision of the wound margins with extensive undermining required; B, same wound fifty-one days following delayed suture.

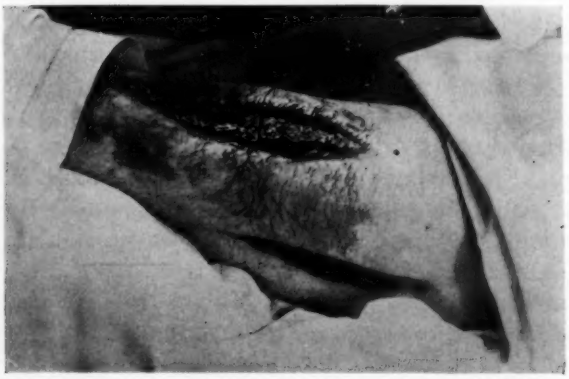


FIG. 4. Appearance of two wounds with a long time interval (forty-two days); note the overgrowth of granulation tissue and the contracting scar.

tageous in the older wounds with an overgrowth of granulation tissue in the presence of a contracting scar. (Fig. 4.) In this group there was 91 per cent healing.

Skin graft was used to a limited extent but usually in conjunction with one of the other methods of closure. It was used to a greater extent and with somewhat better results than indicated herein after this study had been completed. A skin graft was used alone in eight cases, with a healing rate of 78.8 per cent. It was used in conjunction with a delayed suture in thirteen instances, with a healing rate of 83.8 per cent.

Infections were encountered in 15 per cent of the preoperative and 21 per cent of the postoperative wounds. Twenty-two required incision and drainage of abscess formations when first examined while several other wounds necessitated revision with removal of retained foreign bodies or sequestrated bone fragments. The remainder required forty-eight to seventy-two hours or longer of wet dressings before a delayed closure was deemed advisable. Sixty-three of the 111 preoperative wound infections showed some degree of infection postoperatively. Of the 721 wounds, 154 or 21 per cent were infected following surgery. This varied from a very slight infection which, following a couple days of moist heat, still resulted in a 90 to 95 per cent take, to more severe infections resulting in a total loss of the closure or skin graft. There were twenty-nine wounds in which a total failure resulted; of these, nineteen had been infected preoperatively.

Numerous reports[15,25–30] have appeared in the literature referring to the topical use of the chemotherapeutic agents in localized wound infections. Some of the reported results have been quite encouraging while others, particularly with reference to the sulfonamides, have been discouraging.[30] Although both sulfa drugs and penicillin were available in adequate

amounts, local chemotherapy was not employed in any of our infections. This experience did indicate, however, that under the protective wing of systemic penicillin and sulfa therapy adequate wound revision, drainage and the removal of sequestrations could be safely accomplished at a time of election without fear of initiating a rapidly fatal, invasive infection.

Some of the infections were quite severe and stubborn but none were fatal; this includes two patients with clostridial myositis. It should be emphasized that an attempt was made to close *all* wounds. Persistent infections were responsible for virtually all of the long time intervals. Even those wounds in which a partial to complete loss of the closure or skin graft occurred were not allowed to heal by granulation but were cleaned up with a few days of moist dressings plus additional systemic penicillin and a resuture or skin graft accomplished.

EVALUATION OF RESULTS

The results of this analysis are presented in Figure 5. Each wound was critically evaluated on a degree of percentage basis and no wound was considered 100 per cent healed unless primary repair was present at the time the sutures were removed. This was usually five to ten days following delayed suture. There were 512 wounds in which 100 per cent primary healing had occurred by the time the sutures were removed. A factor worthy of note is that approximately three-fourths of these were in wounds with a time interval of seven days or less.

It is to be noted that in the three-day interval group there was 86 per cent healing which, when compared to the 97 per cent healing in the fourth and fifth day groups, is not too satisfactory. It might be assumed that nature's defense mechanism was rushed somewhat in the three-day group. This assumption is well supported by the experimental work of Berman and his associates[36] who found that localized immunity against infection was not present in wounds up to twenty-four hours old. However, in 48-hour wounds they found a 50 per cent immunity, in 72-hour wounds 70 per cent immunity and in 96-, 120- and 144-hour wounds there was 100 per cent immunity. The fundamental significance of this experiment when correlated with the clinical findings in this analysis may be readily appreciated.

The degree of healing in the six- and seven-day groups dropped but still remained above 90 per cent. However, after the seven-day interval the percentage dropped quite rapidly. Including those wounds in which no healing occurred the over-all degree of healing for 721

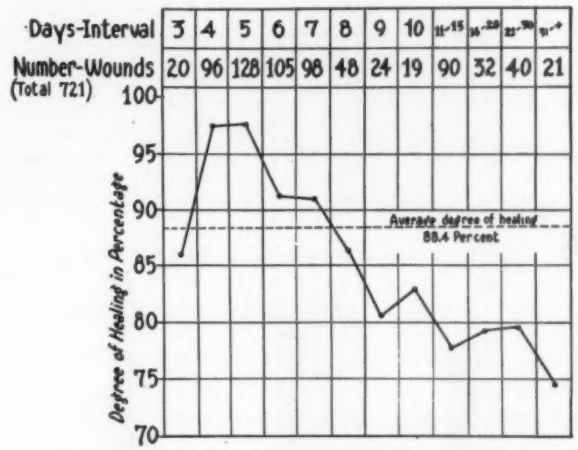

Days-Interval 3 4 5 6 7 8 9 10 11-15 16-21 22-30 31-?
Number-Wounds (Total 721) 20 96 128 105 98 48 24 19 90 32 40 21
100
95
90
85
80
75
70
Degree of Healing in Percentage
Average degree of healing 88.4 Percent

FIG. 5. Influence of the time interval between the primary and secondary operations upon the healing of 721 wounds; note the fourth and fifth day optimum time interval and the drop in healing percentage with the longer time interval.

consecutive, unselected wounds was 88.4 per cent.

From a military as well as economic point of view a most important consideration is time lost from duty. This became of vital importance in Europe during the winter and spring of 1945 when the manpower shortage of combat soldiers was particularly acute. Therefore, the return of the wounded to combat duty becomes one of a surgeon's most important primary missions. That this was efficiently accomplished is attested by the fact that of 142,121 battle casualties admitted to hospitals in the European theater, approximately 80 per cent were returned to full duty.[7]

Even though wounds are healed various factors may prolong the required period of hospitalization or interfere with the patient's return to duty. Not infrequently symptoms of gastric or duodenal ulcer, cholecystitis or troublesome diarrhea may develop. Occasionally a well defined psychoneurosis became evident. Such symptoms were thoroughly evaluated and x-ray examinations made when indicated. Although the wound may not appear to have any direct association with certain remote symptoms, it should in most instances be regarded as the principal etiologic factor,

and, therefore, the responsible agent in hospital stay and "return to duty" status.

Since optimum time interval has been shown to exert a very favorable influence on repair in delayed suture, it would be reasonable to anticipate a similar influence on the post-

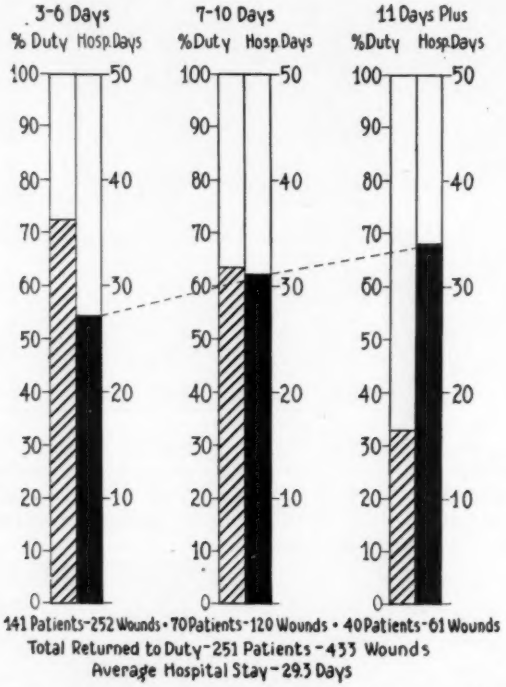

3-6 Days
% Duty Hosp.Days
7-10 Days
% Duty Hosp.Days
11 Days Plus
% Duty Hosp.Days
141 Patients-252 Wounds • 70 Patients-120 Wounds • 40 Patients-61 Wounds
Total Returned to Duty-251 Patients-433 Wounds
Average Hospital Stay-29.3 Days

FIG. 6. Influence of time interval between the primary and secondary operations upon the postoperative hospital period and the "return to duty" status of 433 wounds in 251 casualties; note the dotted line indicating the increase in hospital stay with the longer time interval.

operative hospital stay and the "return to duty" status of wounded patients. For practical purposes an analysis of wounds rather than casualties in this respect would seem to provide a reliable index. Thus it was learned that 251 casualties with 433 wounds were returned to duty in an average of 29.3 days. A further breakdown as shown in Figure 6 clearly demonstrates the fact that time interval does influence the postoperative hospital stay as well as "return to duty" status of the patient. Thus in those wounds with a time interval of three to six days 141 patients with 252 wounds (72 per cent of the total in that group) were returned in an average of twenty-seven days. In wounds with a time interval of seven to ten days 62 per cent (seventy patients with 120 wounds) were returned to duty in an average of thirty-one days; in wounds with a time interval of eleven days or more only 33 per cent (forty patients with sixty-one wounds) were returned to duty in an average of thirty-four days. A seven-day increase in the hospital stay of one patient or of ten is no great concern; but when this prolongation is multiplied by

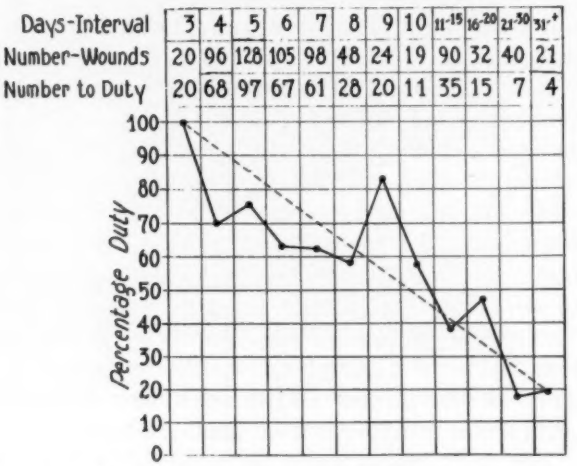
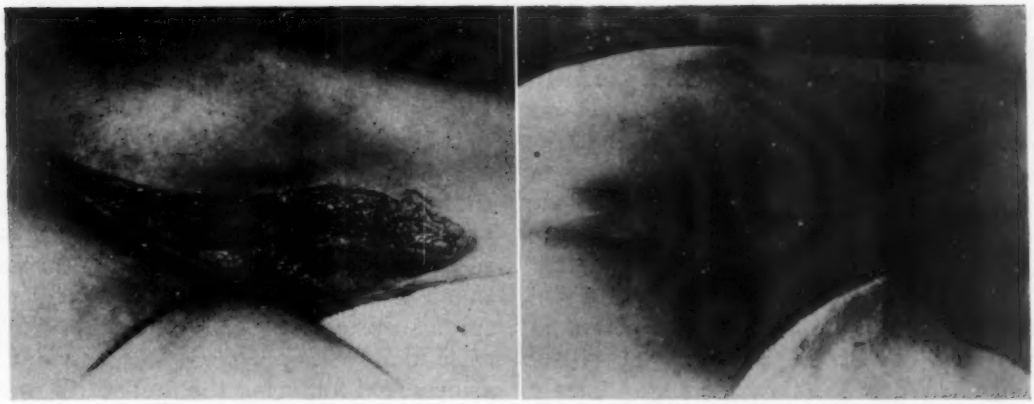


FIG. 7. Day-to-day influence of the time interval between the primary and secondary operations upon "return to duty" status; note the rapidly decreasing percentage of patients with wounds returned to duty with increase in time interval.

several hundred patients, the economic loss is at once apparent.

Again based on an analysis of wounds (rather than casualties), Figure 7 shows the percentage returned to duty in each day-interval group and therefore demonstrates the influence of time interval on the "return to duty" status. It is admitted that many patients not returned to duty could not be salvaged, regardless of the time interval factor, as they represented the complicated wounds such as those associated with severe compound fractures, nerve injuries, amputations and abdominal and thoracic injuries, and were therefore candidates for the Zone of the Interior from the onset. It should be borne in mind, however, that many patients with fractures and abdominal and thoracic injuries were salvaged with prompt reparative surgery and returned to duty from base hospitals. Even if these complicated wounds are eliminated, uncomplicated wounds remain in which a prolonged time interval permits chronicity to develop in the wound as well as a psychogenic attitude in the patient which does not lend itself well to delayed suture and early return to duty. These patients required extensive physiotherapy, psychotherapy and re-



8 9

FIG. 8. Extensive wound of the buttocks which did not benefit from delayed suture but was allowed to heal by granulation; same wound illustrated in Figure 9.
FIG. 9. Deep, deforming, contracted scar present in a wound which healed by granulation.

habilitation which at times was exceeded by a demand for beds, resulting in their evacuation to hospitals farther to the rear. It is reasonable to believe that most of these patients were successfully rehabilitated and returned to duty somewhat later.

There was an over-all average of 29.3 days for the postoperative hospital stay of the 251 patients (433 wounds) returned to duty. Although the application of delayed suture in the management of wounds is now an established and accepted procedure, it appears advantageous to contrast the twenty-nine-day hospitalization in this analysis with that found in an earlier follow-up study of Tunisian battle casualties who did not benefit from delayed suture.[31] Many patients were interviewed in base hospitals (Fig. 8) who were still convalescing from their uncomplicated soft tissue wounds two to four months after their initial surgery. Consequently, many had developed deep, deforming scars (Fig. 9) which were requiring extensive physiotherapy and rehabilitative measures.

COMMENT

The application of delayed suture in the management of traumatic wounds is but one of many notable advances that have developed from experiences in the last war. Equally notable achievements have been made in the initial care of the wounded. New concepts in resuscitation, particularly in regard to the use of blood and plasma, have been crystallized. Unpredicted progress has been made in all the surgical specialties, especially in thoracic surgery.

In the literature from 1918 through 1920 there was a tremendous number of contributions on the management of battle injuries. As we peruse some of these illuminating contributions, we are able with little effort to capture a measure of the enthusiasm with which our surgeons had returned and eagerly described the many new advances which had accrued from their war experiences. As we read further we develop a sincere admiration of their keen insight and marvel at the clear fundamental concepts which they had formulated on the surgical management of war wounds. It is true that many refinements have been added but *one cannot but wonder to what greater heights we might have climbed had we started where they left off rather than where they began.*

On November 22 and 23, 1918, a symposium was held by the Research Society of the American Red Cross in France. This conference was attended not only by representatives of our medical department but also by representatives of the medical departments of our allies. The opinions expressed in reply to previously prepared questions were based on a background of experience which, in the case of the medical officers of our allied armies, covered the entire war from 1914 to 1918. In his opening remarks at this meeting, Brig. Gen. J. M. T. Finney made the following statement: "The transactions of this meeting will be kept in some permanent form so that in the event of another war—God forbid—we will have, at any rate, a record of the combined experiences of those who are present."[32]

To the credit of former Surgeon General Ireland and a corps of outstanding medical men

such as Finney, Crile, Pool, Young, Lee, Brackett, Frazier, Cannon, Goldthwait, Zinsser and many others a most excellent permanent record in the form of a Medical History[33] was prepared. However, it is unfortunate that the knowledge to be gained from that record or from the literature was not disseminated or made available to medical officers destined to be entrusted with the care and management of battle casualties in World War II. Many of the lessons learned and definitely settled in World War I had to be relearned by costly experience in World War II. One may honestly ask, "Why?" The answer is not known but we have a theory. From a further perusal of the literature of that period it can be deducted that for a time the enthusiasm of our surgeons over their recent advancements and observations was received with equal enthusiasm and interest by their surgical confreres—and then the unspoken question: "Doesn't he know the war is over"? The respectful yet bored silence with which a paper is received soon informs the essayist that he is dropping his contribution upon deaf ears. Interest waned, feebly struggled and eventually withered to complete extinction.

Thus it is not surprising that several years later (1927) when the war's medical history was finally completed and presented to medical libraries it quickly found its way to rear, unused and inaccessible book shelves. Although bulging with gems of surgical wisdom, interest in its content faded into complete oblivion. Through the years its existence was virtually unknown to the students and graduates who spent hours in the medical school library. Surgical textbooks were published, revised and reprinted with scant if any mention of many costly attained lessons, including the subject of this paper. Albert Carless,[34] a former Colonel and Consulting Surgeon in the British Army, was on the other hand still mindful of the need of a small chapter (seventeen pages) on military surgery when in 1924 he revised his "Manual of Surgery."

CONCLUSION

The application of delayed suture in the management of wounds is now an established surgical procedure which can with advantage be adapted to the treatment of traumatic civilian wounds. Many of these are by their nature minor in comparison to the average war wound and will therefore, after thorough débridement, prove amenable to immediate primary suture. However, these wounds associated with excessive contamination, marked tissue destruction or a prolonged time lag between injury and treatment will be more safely handled by delayed suture. Moreover, there are numerous other peacetime surgical procedures in which delayed suture is being successfully employed.[35] It is our earnest hope that this as well as many other dearly acquired surgical principles will not again wither to extinction or be relegated to archival oblivion, as occurred following the first world war.

SUMMARY

In a series of traumatic wounds in which delayed suture was utilized time interval has been shown to exert a vital influence on wound repair as well as hospital stay and "return to duty" status. This investigation has revealed that the optimum time interval for delayed suture is four to five days following the initial wound surgery.

Seventy-two per cent of those patients with wounds closed in six days or less were returned to duty in an average of twenty-seven days whereas in those with a time interval of seven days or more only 49 per cent were returned to duty in an average of thirty-two days. Since healing approaching 100 per cent may be obtained in wounds closed during the optimum time interval, it would appear that the scope of delayed suture might with advantage be extended beyond the realm of traumatic surgery.

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PRIMARY CARCINOMA OF THE JEJUNUM

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CARCINOMA of the small intestine has always been considered comparatively rare, comprising roughly almost 3 per cent of all carcinomas. Of this 3 per cent less than 1 per cent have been carcinomas of the jejunum so that relatively speaking we can consider carcinoma of the jejunum as being rare, indeed. What is of more interest even is that an extremely smaller percentage of cases have been diagnosed preoperatively. The usual procedure is the opening of the abdomen primarily because of an acute or subacute obstruction and the finding of a malignant lesion of the jejunum.

In view of the fact that the clinical picture up to the point at which actual obstruction takes place is an almost constant one and that numerous aids to early diagnosis are available, earlier operability and greater chance for alleviation of the patient are possible. If for no other purpose than recording the cases for statistics, all cases of carcinoma of the jejunum should be reported. The case included herein is presented because of the experience gained by the authors.

It has been assumed that the jejunum is relatively immune to the development of primary malignant change. The assumption is correct but the reason for such immunity is still in obscurity.

When, however, many writers compare the jejunum with the duodenum in the degree of immunity present in both regions and are quite willing to consider the jejunum as being less immune than the duodenum, their statistics do not bear out such deductions. A survey of the literature will reveal many cases of carcinoma of the jejunum reported with only an extremely rare primary carcinoma of the duodenum. The latter's description was so confused as to arouse some degree of skepticism as to its authenticity. However, fairly impressive statistics with regard to the occurrence of primary carcinoma of the jejunum exist which illustrate its rarity of occurrence. Perhaps most noteworthy of these because of the known thoroughness and reliability of the compiler were those of Nothnagel.[2] In a series of 25,360 autopsies he found 243 cases of intestinal carcinoma, but among these 243 cases there was not a single case of carcinoma of the jejunum.

Wolfsohn[1] in Germany some years ago made extensive biochemical studies as to the resistance of the upper small intestinal tract to carcinoma. However, the conclusions arrived at were somewhat vague and stressed only the constant alkalinity, the acid-base equilibrium and the absence of mechanical irritation due to the fluidity of the chyme. These things had long been known and discussed.

Later statistics compiled in 1922 in Vienna revealed that in a series of 41,800 autopsies consecutively performed there, 343 cases of intestinal carcinoma were found; yet among these 343 cases not a single case of carcinoma of the jejunum was demonstrated. Many of the large clinics of the world with their attendant wealth of material have never had a case and many gastroenterologists and abdominal surgeons with extensive experience have never seen a case.

Many theories and speculations have been advanced in an attempt to explain the rarity of the occurrence of carcinoma in the intestine in the region between the pylorus and the ileocecal valve, more specifically in the jejunum and ileum. Some of these theories are as follows: (1) The fluid nature of the intestinal contents in this area eliminates the possibility of mechanical irritation of the intestinal mucosa by the food column, as exists in the remaining portions of the elementary tract. (2) The constant alkalinity of the intestinal tract in this area may be the factor in prevention. (3) The absence of mechanical hindrances in the small intestine, such as kinks, abrupt turns, anatomic deviations and such, favors the free passage of the column of chyme in contrast to the stasis possible in other regions with the possibility of attendant mechanical irritation.

In an effort to substantiate any or all of the aforementioned theories attention has been called to the greater frequency of malignancy

in the upper and lower ends of the intestinal tract and the rarity of a lesion in its mid-portion. It is pointed out that in direct proportion as the distance from these two points increases so is the incidence of carcinoma proportionately rare, as is conversely true. All of these theories hark back to Nothnagel[2] and were not original with him.

SYMPTOMS

Clinically, the symptomatology of carcinoma of the jejunum is dependent entirely upon what degree of obstruction is present, if any. Based entirely upon a review of the literature and personal experience limited to these cases, the following would be listed as the most prominent symptoms encountered:

First and foremost, pain is perhaps the most important symptom and that more commonly complained of by the patient. Pain is more apt to be intermittent, colicky in type and has no relation to food intake, although patients usually state that the pain is worse, more frequent and intense after eating. There is, however, no periodicity and rarely is it accompanied with any pyrosis.

Flatulence causes considerable upper abdominal distress, usually described as a sensation of epigastric fullness and heaviness, bloating, with gas distention, eructation of gas which gives a fleeting feeling of relief, or a feeling of fullness in the entire abdomen with much borborygmus, also with fleeting relief if able to expel gas per rectum.

An important point in history taking is that relative to constipation. Usually it can be elicited that whereas formerly bowel function was quite regular and satisfactory, there has been a tendency to an increasing and obstinate constipation of late. Some may describe alternate periods of diarrhea and constipation but almost always there is the story of change from a former regularity of bowel habit.

Another symptom is that of vomiting. The vomitus consists usually of large amounts of fluid which may or may not be bile-stained. The large amount can be accounted for by an accumulation of several meals above the point of lesion. Patients do sometimes describe the vomitus as containing particles of food which they recognize from two to three meals earlier. Occasionally there may be vomiting of blood which is more significant in retrospect diagnosis rather than of the moment. Some patients will voluntarily induce vomiting to obtain relief, particularly of the upper abdominal fullness and distention. One of the patients mentioned in this series induced vomiting every night prior to retiring; otherwise sleep was impossible.

Weight loss is progressive and continuous even though the daily caloric intake is kept at normal.

Anemia is of the secondary type, usually occurring very early in the course of the disease. Many times it may be the earliest or only symptom present. It is progressive in type and is due to the slow loss of blood from the lesion into the intestinal tract and the stool.

Professor Denk[4] of Graz and Vienna first called attention to the presence of anemia simulating pernicious anemia in these cases and of a symptom triad, namely, anemia, extraordinary fatigue and emaciation. It was his contention that this syndrome occurred most often in a non-stenotic type of lesion which was even more rare than the constricting obstructing type and that it was often present for a considerable time before actual demonstration of such a lesion was possible by our ordinary methods of diagnosis.

Cachexia occurs curiously enough only in the very late stages of the disease and, when found, is an indication of a very poor prognosis and evidence of a very late stage of the disease.

The presence of the previously described train of symptoms before the patients present themselves for diagnosis has varied in the reported cases of carcinoma of the jejunum for from two months to three years. There are two factors which influence the rate of increase and extension of symptoms, namely the type and grade of the carcinoma cell present and the individual resistance to the disease.

Clinical Features. The onset of symptoms may be slow, insidious in character, or they may be sudden, acute emergency in character, due to the presence of an acute intestinal obstruction and this latter may be the first call of attention to the disease. Perhaps a most important point to bear in mind from the standpoint of diagnosis is the following: A patient may present the picture of a mild acute obstruction, sudden, severe, acute, colicky abdominal pain, considerable distention with gas, nausea and vomiting, borborygmus, even some degree of shock and in the course of a few hours this entire clinical picture may clear up. A patient

presenting such a syndrome should have a complete detailed gastrointestinal examination in the interest of early diagnosis; since, if the case is one of possible jejunal malignancy, in the course of a few weeks or a few months a repetition of the aforementioned symptoms will occur, perhaps with increased severity and time has been lost in arriving at a diagnosis and consequent early operation. More poignant is the fact that as these symptoms occur most often after a substantial meal there is an all too frequent tendency to classify them as "acute indigestion" and pass over them too lightly.

Physical Signs. Those signs which present themselves most often are apt to be fairly constant. Tenderness is present, usually focally located below the umbilicus, although it may be situated just to the left or to the right. What is most important is that it is usually localized directly over the lesion. Muscle spasm is sharply localized in the area of the lesion, not disseminated into the surrounding area. A palpable tumor may or may not be present as it is dependent upon many variable factors such as the size of the lesion, the depth and anatomic conformity of the abdomen, the type of lesion, its stage of development and whether the lumen of the bowel is involved or only the external wall.

Tarry, long stools or presence of occult blood in stools is always a physical sign of extreme importance. The importance of frequently repeated examinations for the presence of blood in the stools in a suspected case of gastrointestinal malignancy goes without saying, but it cannot be overemphasized. It also goes without saying that these examinations for occult blood presume that the patient has been kept on a meat-free diet.

SURGICAL PATHOLOGY

A review of the reported cases of jejunal carcinoma discloses that the majority of cases have been of the adenocarcinomatous type. The most common forms reported are those which have developed upon a degenerating polyp, an argument in itself for the removal of any simple polyp in either the jejunum or ileum while still in the ring type or encircling, constricting type, which is usually infiltrative in character and penetrates symmetrically into the deeper layers of the jejunal wall. It is this form which is most apt to produce the obstructive type of symptoms.

Kuttner[5] has called attention to the presence of polyps in the jejunum in association with jejunal carcinoma and reflected upon the presence first of a benign polyp which some time later undergoes degenerative change. The basic cause, a primary benign polyp, should be removed while still benign if at all possible. He has also called attention to the association of the jejunal diverticula in these cases although in a small percentage, and reasons that the degenerative changes may take place as the result of mechanical irritation within the diverticulum or diverticula.

Ewing[6] in describing jejunal malignancy states that it is usually a part of a local or general intestinal polyposis which has undergone local malignant change. Otherwise in his experience, malignancy of the jejunum represents a late development of or in a multiple carcinoid tumor. This carcinoid type of tumor is that described by Lubarsch[7] as found in the intestine, called carcinoids by him, and which in appearance simulates pancreatic island tissue or the structure of Brunner's glands of the duodenum. The etiology and true malignancy of these tumors has not as yet been satisfactorily ascertained. We do know that they occur mainly in elderly individuals, are more often multiple in nature, usually do not cause any clinical symptoms or signs and have been found and described mainly from postmortem examination. They probably represent anomalies in embryologic development or changes occurring in misplaced gland tissue as the result also of embryologic deviation.

Kuttner[5] in describing specifically malignancy of the jejunum speaks of it as a localized adenocarcinoma with variable carcinomatous changes in the microscopic structure.

Ewing[6] elaborating further calls attention to certain general characteristics of jejunal malignancy as follows: It may produce polypoid outgrowth which obstructs the lumen of the bowel. It may undergo ulceration and penetrate and burrow into the deeper layers of the bowel wall. It may produce constriction and stenosis due to infiltration of the muscularis and subserous layers by the malignant cells. If constriction or stenosis takes place, there is a compensatory dilation of the bowel above the constricted area caused by mechanical dilation of a food column which cannot get through and pass on. Most of the cases described have been

found in the anatomic portion of the jejunum nearest to the ligament of Treitz.

DIFFERENTIAL DIAGNOSIS

Once attention has been directed to the jejunum as the anatomic site of the lesion present, differential diagnosis presents no great difficulties. Only a few deviations from normal occur in this area, which must be considered in a differential diagnosis, and are specifically the following: Benign tumors such as fibroma, lipoma, hemangioma, leiomyoma and polyp may all produce the same symptom complex and physical signs except that such types of tumors are more apt to occur earlier in life and usually do not bleed. Therefore, they do not produce the profound anemia so frequently associated with jejunal malignancy and rarely, if ever, produce blood in the stools, hence positive occult blood findings.

Sarcoma of this portion of the intestine is also most apt to occur at an earlier stage in life. The symptoms are rapidly progressive from the start and the general systemic reaction more sudden, more severe.

Intestinal bands or adhesions, particularly postoperative adhesions, may produce the identical picture, particularly a roentgenologic picture of localized constriction and dilation of the jejunum above the constriction and also the identical train of symptoms complained of, but rarely is there any anemia present, no severe constitutional reaction and no blood in the stool.

Retroperitoneal granulomas must be considered, although such are extremely rare, would have to be in one particular spot only and of such an anatomic conformity as to produce a picture simulating that of jejunal malignancy.

Secondary invasion of the malignant process is usually first into the nearest mesenteric lymph nodes and to the immediately adjacent peritoneum. Finally, there may be metastasis through the blood stream to the liver, lungs and into the long bones. Metastases distinctly influence unfavorably the final outcome of the disease, but in spite of this, it must be kept in mind that in not a few cases what appears to be a metastatic node at operation, under the microscope will show no evidence of any carcinomatous cells and only those changes which are typical of secondary inflammatory reaction. Roblee[8] demonstrated that it can and does metastasize to the ovaries. This is a good point to bear in mind when operating in the pelvis and encountering such a lesion.

TREATMENT

There is only one method of treatment, surgical, and only one contraindication known, demonstrable metastasis to either the liver or lungs. Either of these can be reasonably accurately diagnosed and ruled out. Perhaps the most favorable factors aiding surgical therapy are that as far as is known the rate of growth is very slow and the tendency to metastasize late.

Another surgical point to be kept in mind is that the experience of some of the larger surgical centers has been that what often appeared to be an inadequate operation, based on anatomic and gross pathologic lines, meaning that the excision of the lesion has not been as wide as desired due to technical complications or that the apparently involved lymph nodes have not been completely and satisfactorily removed, has proven to be successful from the standpoint of end result when viewed from the standpoint of years of well being without recurrence. At one time an opinion flourished that primary malignancies of the small intestine did their greatest damage by way of mechanical obstruction and not by metastasis. Time has proven that such a supposition is erroneous.

Radical resection with reestablishment of the continuity of the bowel is the treatment of choice. If radical resection is not possible, gastroenterostomy is performed with the stoma in the jejunum below the lesion, thereby excluding the lesion. To give relief to the obstruction is the only other procedure of choice where it is not feasible to resect.

In those cases in which acute obstruction is present the mortality is very high, while in those cases in which obstruction is not present the mortality is lower. Early diagnosis is desirable as operation done early offers an excellent chance for radical resection with lowered mortality and an average of 20 per cent of five-year cures.

Deep x-ray therapy may be carried out postoperatively, particularly in the case in which dissatisfaction or doubt exists as to the total removal of involved glands. As a means of active specific therapy the consensus is that it has no value.

As an aid to diagnosis the x-ray proves itself of inestimable value. Without apology, one can make the statement that this portion of the intestinal tract is one of the most neglected insofar as specific visualization is concerned. We have found two procedures to be of utmost value in aiding the visualization of jejunal deviation. The first is that of giving the patient small amounts of rugar (a mixture of barium and gum acacia) every hour and taking roentgenograms hourly over the next twelve hours, then every two or four hours after for a twenty-four-hour period. The success attained in visualization by this method can be determined by the roentgenograms used in illustrating this article. A second method has been to give about 2 ounces of barium in 8 ounces of water followed by copious drinking of cold water which seems to stimulate peristalsis and carry the barium rapidly through the stomach into the jejunum, when the usual roentgenograms can be made. The usual precautions, if obstruction is suspected, are observed.

Inasmuch as all three of the cases observed merely illustrate the aforementioned points and no radical deviations were encountered, for the sake of brevity only one of these will be described in detail as nothing would be gained by citing all three.

CASE REPORT

Mrs. C. W., age fifty-seven, came for a complete gastrointestinal examination and complained of vague gastric distress with symptoms centering mainly in the upper epigastrium.

Present symptoms began about five years previously following a period of severe mental and physical strain. At that time she began noticing a fullness and a sense of weight in her epigastrium, particularly after meals.

After almost six months this sense of weight and fullness increased to such an extent that she would frequently induce vomiting to obtain relief. At almost this same time she noted that nausea and vomiting were present and that the vomitus would consist of a pint or more of bitter liquid, frequently dark, containing many granular appearing particles. It never contained any gross blood or blood-tinged particles. Her distress was greatest at night and frequently there was associated heartburn and acid eructation, but she was never able to obtain relief by taking soda bicarbonate or alkalies.

Six months previously vomiting began to increase in frequency and she noted a definite change in bowel habit, becoming increasingly constipated, but noticed no changes in color, consistency or form of stools. Six weeks before admission she had her first attack of diarrhea in years which lasted about two days. This was followed by an obstinate constipation and had been preceded by same. At this time she noted waves or ripples of peristatic bowel action across her abdomen from left to right, usually initiated in the left upper quadrant and terminating, she thought, in the right lower quadrant. At this time, also, she first noticed intense fatigue and general weakness.

Her family history was non-contributory; there was no history of carcinoma. Her past history showed she had had malaria and typhoid fever in childhood. Since childhood, she had always complained of recurrent attacks of colicky pain in the right lower quadrant for which she was operated upon eighteen years previously. At that time a kinked loop of bowel was found bound by adhesions and these were resected. Her right ovary and appendix were removed and a suspension of uterus done at that time. She was not told whether this loop of bowel was of the large or small intestine, but she remained entirely well after this operation up to time of the onset of this illness.

Physical examination revealed a fairly well developed woman, scant growth of body hair, skin very dry, obvious skin changes because of drastic weight loss and a moderate secondary anemia. There was a right lower quadrant linear scar from a previous operation. No masses were palpable; there was sharply localized tenderness below the umbilicus in the midline and circumscribing the umbilicus. There were visible peristaltic waves travelling in an antiperistaltic direction from left to right across the abdomen, just above the level of the umbilicus. There was fairly marked distention of the entire abdomen and audible borborygmus throughout. Palpation in the region of the umbilicus induced nausea and vomiting, the vomitus being entirely liquid, not bile or blood-stained.

The laboratory findings were as follows: Blood: the complement fixation test was negative; hemoglobin, 78 per cent; red blood count, 3,240,000 and white blood count, 6,400. The differential blood count was as follows: neutrophiles, 58; large lymphocytes, 16; small

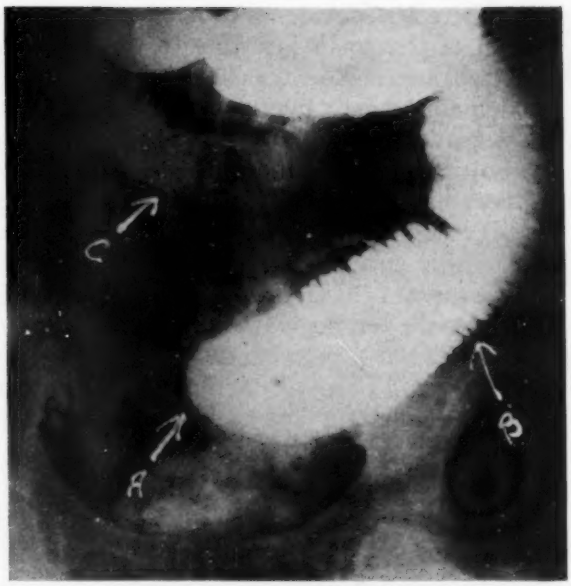

FIG. 1. A, point of obstruction, first portion of jejunum; B, increased multiplicity of jejunal folds; C, dilation of proximal jejunum and of duodenum to pylorus. (Compare roentgenologic picture and actual resected section as to arrangement of folds.)

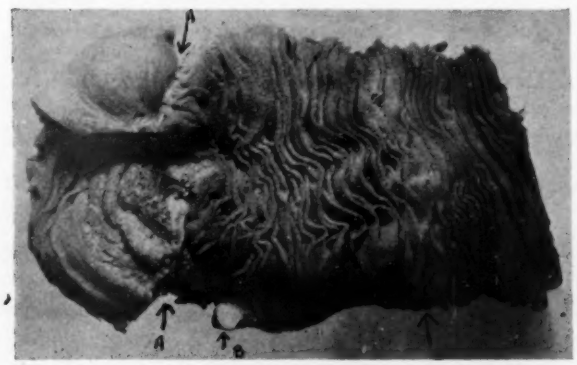

FIG. 2. A, annular constricting lesion causing obstruction and dilation of proximal jejunum and duodenum; B, adjacent non-malignant lymph node; C, arrangement of multiplicity of folds in proximately dilated jejunum.

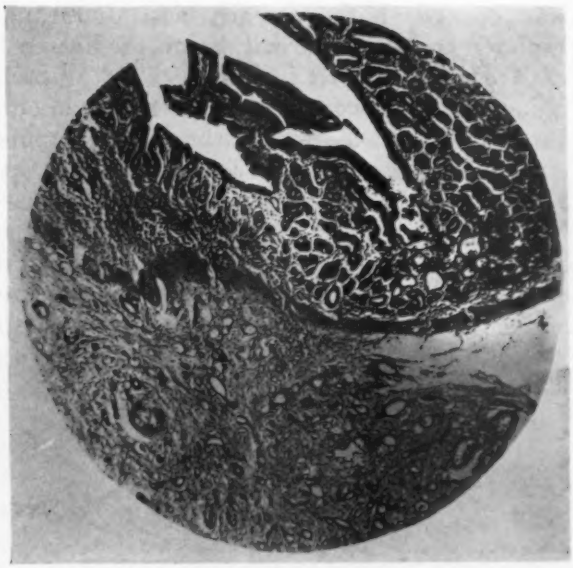

FIG. 3. Microscopic section from lesion illustrating infiltration of tumor cells.

FIG. 4. Microscopic appearance of mucosal and submucosal layers.

lymphocytes, 22 and eosinophiles, 4. Urinalysis: albumin was negative; sugar, negative and specific gravity, 1,020. Repeated examinations for occult blood in the stools were negative. Blood chemistry revealed the following: nonprotein nitrogen, 39.1 mg. per cent and blood chlorides, 530 mg. per cent. In the gastric analysis the free hydrochloric acid was 10 to 23 per cent over two-hour period. Total acidity was 35 to 42 per cent over two-hour period.

Roentgen examination revealed that the stomach was outlined normally; there were no defects in the outline of the greater or lesser curvature. The mucous membrane pattern was normal; no pylorospasm was present. The duodenal bulb appeared normal with no irregularity of superior or inferior borders, and it emptied normally. At six hours there was about a 30 per cent gastric retention with the barium meal in a dilated loop of the upper jejunum. At twenty-four hours there was a small barium residue in both the stomach and jejunum.

Impression: obstruction, partial, in upper loop of jejunum. (Fig. 1.)

At operation a midline incision was made extending from ensiform to umbilicus which was developed down through rectus muscle and fascia to the peritoneum. The peritoneal cavity

was opened, both stomach and duodenum explored and found normal. Below the ligament of Treitz, about 18 inches distally, a small indurated ring was located in the jejunum. Proximal to this induration the entire jejunum was dilated, its wall thickened and of a doughy consistency. There were approximately five enlarged glands along the mesenteric border, the largest being about the size of a pea and extremely hard on palpation. The number, size and consistency of these glands appeared to justify a conclusion that extensive infiltration via the lymph channels precluded any prospect of a cure being accomplished.

The involved area was easily resectable and an end-to-end anastomosis of the jejunum was made. The glands were excised singly as was also a portion of the immediately adjacent mesentery.

Postoperative recovery was uneventful and on the tenth postoperative day a course of deep x-ray therapy was begun which was repeated again six months postoperatively.

The patient gained weight and there has been no gastrointestinal distress. The patient feels symptomatically improved.

The gross and microscopic sections are illustrated. (Figs. 2, 3 and 4.)

CONCLUSIONS

1. Primary carcinoma of the jejunum because of its tendency to slow growth and late metastasis offers excellent prospects of surgical cure provided diagnosis can be made early, and to this end all efforts should be devoted.

2. There is a prevalence to relegate the upper portion of the small intestine to the limbo of forgotten areas. Roentgen examination in the usual manner may overlook the jejunum entirely until it is too late, when recognition is all too obvious, and the patient's chances for recovery have been sadly diminished.

3. It is with the idea in mind of calling attention to this entity, which admittedly is rare, that we present this article. We want to emphasize that the etiologic factor in production, particularly of upper abdominal symptoms followed by a fairly definite train of other symptoms makes it not overdifficult to diagnose, and by the application of the best in roentgen technic, the diagnosis is easily confirmed.

4. If only for statistical purposes all cases of malignancy of the jejunum should be reported.

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HYPEREXTENSION INJURIES TO THE FINGER JOINTS

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AMONG the commonest of all traumatic deformities is the "baseball finger" in which there is disruption of the attachment of the extensor tendon to the proximal dorsal tip of the terminal phalanx. The injury may consist of detachment of the tendon itself but usually the bone is fractured and comminuted at the site of tendon insertion and there is some separation to be seen on x-ray. The usual textbook explanation of this injury attributes it to forceful rapid flexion of the distal phalanx. The author wishes to emphasize that this injury is more likely to be a result of forceful hyperextension than of flexion and often it is due to a direct blow at the tendonous insertion.

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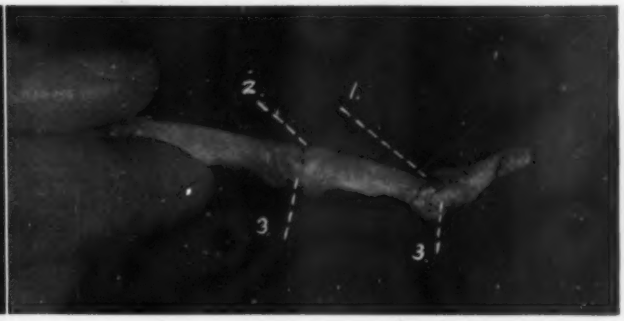

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FIG. 1. Dissection specimen showing intact interphalangeal ligaments (1) and the bony protuberances at the insertion of the extensor tendon at (2) the distal phalanx and (3) the proximal phalanx; note that the interphalangeal ligaments are sturdy structures.

FIG. 2. Dissection specimen of finger showing hyperextension at distal joint; note that point of insertion of extensor tendon (1) is pressed against dorsum of middle phalanx by action of interphalangeal ligaments. Bony protuberance at site of insertion of the middle slip of the extensor tendon has been pinched off already by hyperextension at the proximal joint (2); note sturdy interphalangeal ligaments (3).

The fact that this injury can be brought about during such trivial maneuvers as adjusting bed clothes (Smillie, Watson-Jones) or by the simple maneuvers of stripping off stockings (Mason) clearly suggests that the injury is not one necessarily accompanied by violence, even though this injury quite often is also acquired while catching a rapidly pitched baseball. If the reader will refer to Figures 1, 2 and 18, he will see a cadaver specimen with the interphalangeal collateral ligaments still intact. Figure 1 shows the phalanges arranged in their normal resting position; Figure 2 shows what happens at the distal interphalangeal joint on forced hyperextension. The interphalangeal collateral ligaments become quite tense and the nubbin of bone which serves as the attachment of the extensor tendon is jammed against the dorsum of the more proximal phalanx. Here the tendon or bone at the insertion is pinched off. The same mechanism can occur at the proximal interphalangeal joint.

The terminal phalanx of a cadaver was forcefully hyperextended and an x-ray taken with the finger in this position. (Fig. 3.) Here the typical bony injury of baseball finger is seen caused by jamming of the insertion of the extensor tendon against the dorsum of the more proximal phalanx; the bone of the latter being harder at this point as can be seen by its heavier density in the x-ray picture. Figure 4 shows the finger after the hyperextensive force was removed and shows the chip fracture at the site of the insertion of the extensor tendon.

It now becomes obvious how these injuries can be due to hyperextension. In the baseball player it requires considerable force. The strength and size of his ligaments, bones and muscles are increased by continuous exercise. But in the case of a housewife or anyone in whom muscle, bone and ligament are not well

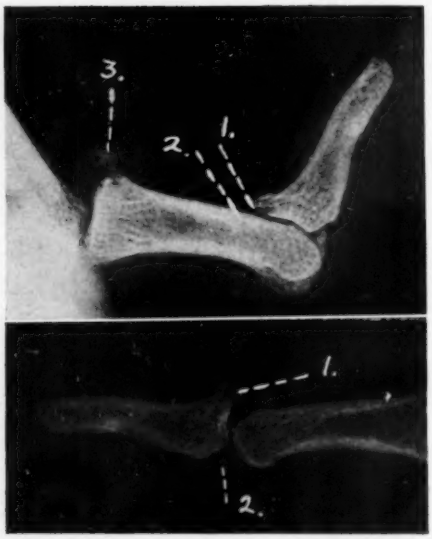

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FIG. 3. Forced hyperextension of cadaver finger showing mechanism of fracture at insertion of extensor tendon at (1) terminal phalanx; note relatively heavy density of bone on dorsum of middle phalanx (2). Note, also, comminuted fracture sustained at site of insertion of middle slip of extensor tendon by hyperextension at this point previously (3).
FIG. 4. Shows a typical "baseball finger" fracture at the site of insertion of the extensor tendon in a cadaver. The injury was brought about by forcefully hyperextending the terminal phalanx. The fragments are comminuted (1) but are not widely separated since there is no pull on the tendon in this specimen. The bony shadow (2) seen on the volar surface of the joint is seen in many routine x-rays of fingers and are apparently unabsorbed fragments from old hyperextension injuries in which the attachment of the joint capsule is avulsed from the proximal volar lip of the phalanx. (Figs. 16 and 17.) These may be seen at either the distal or proximal interphalangeal joints.

developed, there is normally hyperextensibility of the interphalangeal joints as can be demonstrated on most women not used to manual work. This is particularly true of the distal interphalangeal joint in women. In all probability what happens is that these women with long fingernails catch the end of the finger on some light material such as bedclothes or stockings and in making a quick movement forcefully hyperextend the distal interphalangeal joint and pinch off the insertion of the extensor thus sustaining the same type of injury as a baseball player catching a swift baseball on the "tip of the finger." It also becomes evident that the injury need not give x-ray findings since the tendon can obviously be pinched off at its insertion by the impingement of this point against the dorsum of the middle phalanx with little or no bone injury.

Forceful hyperextension of the middle phalanx on the proximal phalanx causes a similar fracture and disruption of the middle slip of the extensor tendon but it is a much more disabling injury. (Fig. 6.) The resultant deformity is, with the finger at rest, flexion of the middle phalanx on the proximal phalanx and hyperextension of the distal phalanx. There is some impairment of motion at the proximal interphalangeal joint but the distal interphalangeal joint remains constantly in the hyperextended position and can be flexed only by forceful passive movement which causes marked pain. Figures 6 and 8 shows the middle slip of the extensor tendon dissected away from the surrounding structures. In Figure 7 the slip is still attached to its insertion at the dorsum of the middle phalanx; in Figure 8 the tendon and the bony nubbin to which it was attached at the dorsal proximal lip of the middle phalanx is separated, having been fractured off from the middle phalanx by forceful hyperextension of this joint. Figure 5 depicts this mechanism in the cadaver specimen. Note the tautness of the collateral ligament and the fractured particle of bone which is the point of insertion of the middle slip of the extensor tendon. Note also in Figure 8 that the lateral slips of the extensor tendon are displaced laterally over the distal head of the proximal phalanx. It is this lateral displacement of the lateral slips of the extensor tendon, which accounts for the peculiar deformity seen in Figure 6. These two lateral slips join in the midline just distal to the proximal interphalangeal joint to form the single extensor tendon going to the distal phalanx which can be seen in Figures 7 and 8. Figure 9 shows an x-ray picture of the hyperextended, proximal interphalangeal joint, with the resultant fracture at the attachment of the middle slip of the extensor tendon. Disruption of the extensor mechanism is obviously the explanation for incomplete extension at the proximal interphalangeal joint. The fixed hypertension with practically complete loss of voluntary flexion occurring at the distal interphalangeal joint is due to the unrestrained tension of the laterally displaced lateral slips of the extensor mechanism. These lateral portions of the ex-

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FIG. 5. Cadaver specimen of finger in forced hyperextension at proximal interphalangeal joint; note taut interphalangeal ligament (1). Fractured fragment at site of insertion of the middle slip of the extensor tendon is seen *in situ* (2). For orientation the proximal phalanx is numbered (3), middle phalanx (4) and distal phalanx (5).

FIG. 6. Typical deformity resulting from disruption of the middle slip of the extensor tendon at its insertion; note swelling at dorsum of the proximal interphalangeal joint, flexion of middle phalanx and hyperextension of distal phalanx. Compare distorted volar aspect of the finger in this picture with the volar aspect of the same finger after it was treated. (Fig. 13.)

FIG. 7. Dissected cadaver specimen showing extensor mechanism of finger; probes (1) and (2) are under the middle slip. Probe (3) is also under the lateral slips. Probe (4) is under the fused lateral slips at their insertion at the distal phalanx; site of insertion of the middle slip at point (A).

tensor mechanism are made up largely of the interosseous and lumbrical tendons. (Figs. 7 and 8.) The peculiar deformity is no doubt due to the combined pull of the interosseous and lumbrical muscles and the common extensor which are no longer limited by attachment to the middle phalanx and now pull solely on the distal phalanx. In the author's case there was some evidence of contracture in these muscles and passive flexion at the distal interphalangeal joint became more difficult and painful as time went along.

Study of this mechanism illustrates how the lumbrical and interosseous muscles extend the distal phalanx and shows, by contrast, how the middle lip of the extensor tendon effectively limits the action of the extensor mechanism by its attachment to the middle phalanx. The limiting action of the middle slip can be enacted readily by the reader. Flex the proximal interphalangeal joint of any finger to 90 degrees. Voluntary flexion of the distal phalanx is now possible but extension is quite feeble and incomplete and remains so until the proximal joint has been partially extended. This is due to the fixation of the extensor mechanism by the middle slip attached to the middle phalanx.

FIG. 8. Dissected cadaver specimen showing (1) fused lateral slips of extensor mechanism distal to proximal interphalangeal joint; this inserts on the distal phalanx at point (2). The middle slip of the extensor mechanism (3) has been disrupted at point (4) by previous hyperextension (post mortem). The lateral slips of the extensor mechanism (5) are composed largely of the tendons of the interosseous and lumbrical muscles. The finger is flexed showing the distal head of the proximal phalanx (6) beneath the point of disruption of the tendon.

CASE REPORT

J. L., a sixty-three year old male shipyard worker, appeared at the First Aid Station complaining of a painful injury to the right forefinger. A heavy steel plate had fallen on the back of his hand in such a way as to forcibly hyperextend his forefinger at the proximal interphalangeal joint. The joint was quite swollen. A straight tongue-blade splint was

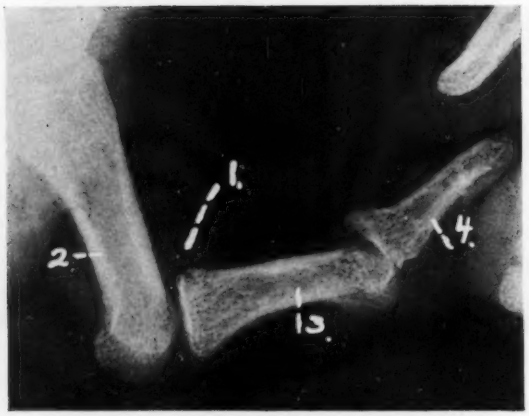
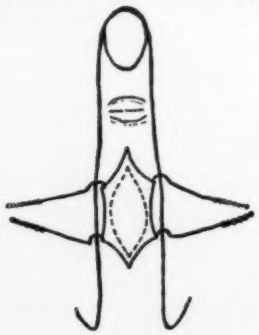


FIG. 9. X-ray of cadaver finger in forced hyperextension; a comminuted fracture has occurred at the site (1) of insertion of the middle slip of the extensor tendon. Note that the density of the bone of the dorsum of the proximal phalanx at this point is greater than that of the part of the middle phalanx impinged against it; (2), (3) and (4) are proximal, middle and distal phalanges, respectively.

applied which the patient wore for an indefinite period and then removed it himself.

Several months later the patient was seen by the author. He presented the typical deformity described above. Active flexion to 80 degrees was present at the proximal interphalangeal joint. The distal interphalangeal joint was fixed in hyperextension and could be straightened only slightly by strong passive motion, and this with considerable pain. Active extension of the proximal joint could be executed only to 45 degrees from the longitudinal axis of the finger. X-ray examination showed no bone injury.

Operation was done under general anesthesia. A longitudinal incision was made over the dorsum of the proximal interphalangeal joint. (Figs. 10 and 11.) The tissues about the joint were quite thickened, scarred and redundant. The lateral tendon slips were buried in this scarred mass of joint capsule in locations ventral and lateral to their normal positions. There was some abnormal mobility of the joint in all directions indicating that the interphalangeal ligaments and joint capsule had been stretched or torn. An elliptical-shaped section of the scar thickened capsule was excised in the midline over the joint. (Fig. 10.) A full thickness section was excised including synovium, exposing the joint. Replacement of the displaced lateral tendon slips to their more dorsal normal position was accomplished by suturing the sides of the opening in the longitudinal axis. (Fig. 11.) This procedure also took up the slack in the redundant joint capsule. Fine interrupted silk sutures were used. Interrupted silk sutures were also placed in the skin and a plaster cast applied with the finger at 180 degrees extension. (Fig. 12.)



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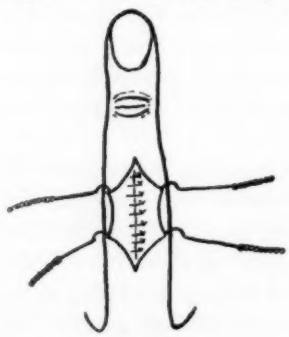

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FIG. 10. A longitudinal incision is made over the proximal interphalangeal joint; the skin is retracted laterally thus exposing the aponeurosis. For purposes of illustration the diagram depicts the skin incision longer than is necessary at actual operation. The area shown by the dotted line is excised. This resection includes underlying synovium.

FIG. 11. The resected area is closed with interrupted silk sutures. This brings the ventrally displaced lateral extensor tendon slips back to their normal position. The skin is then closed and a plaster cast applied from the distal phalanx to mid-forearm holding the proximal and middle phalanges in extension. (Fig. 12.)

Had the patient been operated on earlier, it might have been possible to isolate the middle slip of the extensor tendon and reattach it. But in this case this portion of the tendon was

FIG. 12. Cast includes the wrist joint in order to immobilize the entire extensor tendon. Cast is removed after four weeks.

FIG. 13. Same finger as in Figure 6 two months postoperatively; note straight contour of ventral surface.

imbedded in a mass of scar tissue. Normally the middle slip of the extensor tendon penetrates through the joint capsule in a slanting manner and its course would be very difficult to reconstruct, particularly where cicatricization has already taken place.

The cast was removed four weeks postoperatively. There was considerable limitation of motion but after a few weeks of active use and daily hot water soaks the patient had almost complete active extension and 90 degrees active flexion at the proximal interphalangeal joint. The distal joint rested in full extension but could be actively flexed only 10 degrees. There was marked cosmetic improvement. (Fig. 13.) Four months later the distal phalanx could be flexed 30 degrees. There was some persistent disability due to weakened flexion at the distal joint which reduces the strength of grip in apposition with the thumb. No doubt the distortion of soft tissues around the distal joint which remained subluxated in hyperextension for several months, and contracture of the lumbrical and interosseous components of the extensor mechanism summate to give the effect of weakened flexion at the distal phalanx. These detrimental factors might not be present when the deformity is operated upon early.

Hauck reported four similar cases. He operated upon them and the results were about the same as in the case described herein. He presents an extremely detailed discussion of the mechanism of the deformity and its correction and a detailed discussion of the anatomy and physiology of the extensor mechanism of the fingers. His excellent diagrams are reproduced in a publication by Mason. This injury was originally described by Hauck and no further references are found in the literature until the work of Mason in 1930. Mason also used an operative approach to the problem with good results. Of Hauck's four cases there was direct injury to the insertion of the middle slip of the extensor tendon in three cases, two of the patients having fallen directly on the clenched fist. A third received a direct blow on his knuckle. The fourth patient sustained the injury when a bag was ripped from his clenched fist, no doubt causing hyperextension at the proximal interphalangeal joint and impinging the insertion of the middle slip against the surface of proximal phalanx. Mason's patient sustained his injury by catching a baseball and could have been due to a direct blow or to hyperextension.

Watson-Jones describes a similar deformity under the heading "trigger-finger." The condition is one in which the patient is unable to hold the finger in extension actively unless the finger is first passively straightened. As soon as the patient voluntarily flexes the finger, the lateral slips jerk sideways over the head of the proximal phalanx. It is then impossible to extend the finger until passive assistance is given. As the finger is passively straightened, the lateral tendons snap back from the side to the dorsal aspect of the proximal joint and a trigger effect is produced. Watson-Jones further adds that if no treatment is carried out, all the power of the extensor tendon is concentrated on the terminal joint which gradually hyperextends. Watson-Jones recommends that con-

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FIG. 14. Resting position of finger with old transverse tear of volar aspect of proximal interphalangeal joint capsule; flexion movements are normal. Passively, however, the proximal interphalangeal joint can be hyperextended to 90 degrees from the resting position.

FIG. 15. Finger with old transverse tear of volar aspect of proximal interphalangeal joint capsule gives this appearance on voluntary hyperextension. Note that the distal phalanx does not attain full extension, the lateral slips of the extensor mechanism stand out prominently and the middle phalanx does hyperextend.

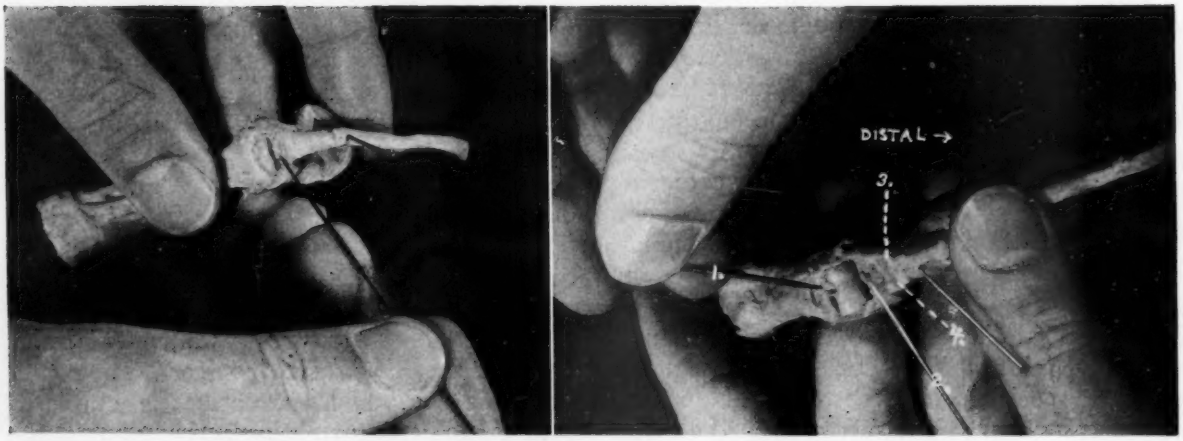

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FIG. 16. Volar aspect of hyperextended distal interphalangeal joint of cadaver; deep digital flexor tendon reflected and transfixed by pin. Needle points to bone fragment broken off ventral proximal lip of distal phalanx at attachment of joint capsule. The insertion of the deep flexor tendon, although immediately adjacent distally, is not involved in the fracture.

FIG. 17. Volar aspect of hyperextended finger of cadaver; proximal interphalangeal joint. The superficial flexor tendon slips have been reflected and transfixed with a pin through the thin tissue between the two slips. Needles (1) and (2) point to bone fragments torn from the ventral proximal tip of the middle phalanx by forced hyperextension. The fracture occurs at the attachment of the joint capsule and is .4 to .6 cm. proximal to the most proximal attachments of the superficial flexor tendon. These tendon insertions begin at points (3) and (4) and extend distally and laterally.

servative treatment be given and that it is effective even when the injury is several weeks or months old. He recommends that the finger be immobilized in a plaster cast with the proximal joint extended. It is notable that neither Hauck nor Mason describe the trigger effect.

Undoubtedly the difference between the type of case described by Watson-Jones and the type described by Hauck, Mason and myself is that in Watson-Jones' case the lateral tendon slips did not become adherent in their abnormal positions and could thus freely jerk up and down around the sides of the distal head of the proximal phalanx. In the cases described by Hauck, Mason and myself these tendons were fixed in scar tissue in the abnormal lateral and ventral positions. This logically explains why in the one case plaster immobilization can bring about a cure and in the other surgical intervention is necessary.

There are two other finger deformities which may be confused with ruptured middle slip deformity. One is complete laceration of the profundus flexor tendon beyond the insertions of the superficial flexor tendon. This results in eventual ankylosis in hyperextension of the distal phalanx and incomplete extension at the proximal interphalangeal joint, probably due to decrease in tension of the extensor mechanism by lack of resistance by the deep flexor at the distal phalanx. The diagnosis is made by detection of a scar at or distal to the proximal interphalangeal flexion crease through which the profundus tendon is lacerated without disturbing the continuity of the superficial tendon. The other condition which may simulate ruptured middle slip deformity is volar transverse rupture of the joint capsule at the proximal interphalangeal joint by hyperextension. Here the extensor mechanism tends to shorten and results in moderate hyperextension of the distal phalanx. However, complete active flexion and extension of both finger joints are present and passively the finger may be alarmingly hyper-extended at the proximal joint. (Figs. 14 and 15.)

Lateral views of 800 injured fingers were picked at random from the x-ray files at the shipyard First Aid Station at the Northern Permanente Hospital. Among these nine recent fractures of the dorsal proximal lip of the distal phalanx with mallet-finger deformity were found. Histories revealed one case was due to hyperextension (fell twisting finger backward).

FIG. 18. Cadaver specimen; needle points to fragment of bone broken off the dorsal proximal lip of the distal phalanx by forced hyperextension. The extensor tendon is held by the operator's right hand. Here one sees that the dorsal part of the joint capsule and the attachment of the extensor tenson are continuous anatomically. This is in contrast to the flexor tendons which insert distal to the joint capsules.

Six were due to heavy objects falling on finger which should be considered direct blows. In two the histories were inconclusive.

Among the 800 films there also were nine recent fractures of the ventral proximal lip of the middle phalanx. Of these, three were hyperextension injuries (fell twisting hand). Four were due to direct blows by falling objects. In one the mechanism was obscure (patient struck another patient). In eight other films smooth bone fragments were seen which suggested similar fractures which failed to unite or absorb; however, it is difficult to prove that these are not sesamoids. A typical example is seen in Figure 4 (indicator number 2). Evidence that these are not sesamoids rests on the facts that they are located somewhat distal to the joint and are not round or oval but are somewhat irregular in shape and that they can be duplicated apparently in the cadaver by hyperextension and anatomically shown to be in the joint capsule attachment. (Figs. 16 and 17.)

In the 800 films there were also four clear recent fractures of the proximal ventral lip of the distal phalanx. Histories showed one to be the result of forceful hyperextension (fell backward on finger), one was smashed between two posts, the other two may or may not have been hyperextension injuries ("caught in

drawer" and "direct blow from above"). Figure 18 shows that the site of the fragments anatomically are at the attachment of the joint capsule.

CONCLUSIONS

1. The common "baseball" or "mallet-finger" is frequently due to forceful hyperextension of the distal phalanx on the middle phalanx.

2. A similar injury occurs at the insertion of the middle slip of the extensor tendon at the middle phalanx. This results in a typical and very disabling type of deformity. The differential diagnosis and treatment of which is described.

3. Bone spicules frequently seen in x-ray on the volar aspects of the interphalangeal joints resemble sesamoids but are usually avulsion fractures at the distal attachment of the joint capsule due to hyperextension or a direct crushing force.

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M. SPRING reports an interesting case of a patient with hyperthyroidism in whom agranulocytosis developed after thiouracil medication. The patient recovered and his toxicity was later successfully controlled by propylthiouracil without untoward effects. The case nicely illustrates the difference in toxicity between these two antithyroid drugs. (*Richard A. Leonardo, M.D.*)

INTERTROCHANTERIC FRACTURE OF THE HIP*

GOTTLIEB S. LEVENTHAL, M.D.
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INTERTROCHANTERIC fractures usually occur in an age period one decade later than intracapsular cervical fractures. A review of the literature impresses one with the high mortality rate. Lucas and Varney[1] reviewed fifty-seven cases in which patients were treated with various methods. They reported twenty-five deaths (43.8 per cent). McKee[2] reported seventeen fractures, with five deaths (29.4 per cent). Stuck[3] reports sixty-five cases, with fifteen deaths (23.1 per cent). Cleveland, Bosworth and Thompson[4] report a mortality of 34 per cent using conservative treatment and 12.6 per cent using internal fixation.

Since January, 1944, a total of twenty patients with intertrochanteric fractures have been treated on the orthopedic service of the University of Pennsylvania Hospital. There have been no deaths. The average age was over seventy-two years. Six patients were over eighty and one was eighty-eight years of age. In the literature one notes that women sustain this type of fracture more often than men. In this series thirteen patients were women.

Three of the fractures were subtrochanteric; the rest were intertrochanteric. Many patients on admission were disoriented, dehydrated, had low hemoglobin and had a disturbed albumin-globulin ratio or lowered blood protein. These patients were considered poor operative risks.

TREATMENT

All but two patients were treated with nailing using the Neufeld nail. Of the two patients treated conservatively, one had a badly comminuted fracture of the entire trochanteric region so that reduction could not be carried out for nailing. This patient was successfully treated with a plaster spica. The second patient, much younger than the others and in good condition, refused surgery. He was treated with traction and a plaster boot with cross board that held the extremity in internal rotation. All the other patients were prepared as quickly as possible for surgery by the use of intravenous saline, amigen and transfusion if necessary.

The choice of anesthesia was left to the anesthesiologist. Cyclopropane with oxygen was used on four occasions. Cyclopropane plus ether and oxygen, and pentothal® with nitrous oxide and oxygen were used on one patient. Cyclopropane, oxygen and pentothal,® pentothal,® and unilateral spinal were each used once. Spinal anesthesia was used on two occasions. Sodium pentothal® and nitrous oxide with oxygen were used ten times. During surgery most of the patients received blood. All of them received saline intravenously. All the patients withstood the anesthetic and surgery very well. They left the operating room in very satisfactory condition.

The fracture was reduced by manipulation and traction. In some patients reduction was obtained when the extremity was internally rotated alone. In other patients it was necessary to rotate the extremity externally to obtain reduction because the upper fragment was in external rotation. The reduction was checked by fluoroscope and films. The center of the neck was found by use of a modification of the Geckeler[5] guide which the author has been using for many years for femoral neck fractures and which has been described by Larsen.[6] A Steinmann pin was placed anterior to the neck directly in the middle by fluoroscopic guidance. The Larsen block was then attached to this Steinmann pin and a Kirschner wire was threaded into the neck as guided by the block. Anteroposterior and lateral x-rays were then taken to check the position of the Kirschner wire. If the reduction was correct, the Kirschner wire would be found to be properly placed. The bottom of the V trough of the Neufeld nail was then fitted against the Kirschner wire and the nail driven in until the flange with the holes was against the shaft of the femur. Three screws held the flange firmly. X-rays in the anteroposterior and lateral planes were taken

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and motion of the hip was checked before the patient left the operating room.

Intravenous medication of saline, amigen and blood was given if found necessary. Prophylactic antibiotics were also administered. The patients were sitting up in bed or in a wheelchair within eighteen to twenty-four hours after surgery. Almost all patients were given the blow bottle to improve pulmonary ventilation. It was very gratifying to find that under this regime the disoriented, noisy patient became a quiet, cooperative individual. He was able to sit up most of the day, even the first week. Side boards in the bed were continued as a precautionary measure rather than of necessity.

Complications. In the early cases the nail selected almost reached the articular cartilage of the head. As a result of using so long a nail the point of one pierced the articular cartilage. The amount of protrusion was so slight that it was detected only after many films were taken in various planes. Since then a shorter nail has been used and has held just as well. Some authors have reported that the nail traveled inward after nailing, but in this series none of the nails traveled in further than when originally inserted. In one early case the nail was driven in too far posterially and had to be removed after one month. One nail broke, presumably from weight-bearing, at least six weeks after insertion. One nail broke through the cephalad part of the proximal fragment and had to be removed.

The patient who had the slight protrusion also developed a mild infection which was well controlled. The nail was left *in situ* until union was complete; it was then removed. When last seen the patient had an almost normal range of motion and walked without pain or assistance. The nail that broke through and the nail that was placed too far posterially in the neck were both removed. Healing occurred with coxa vara and resulted in some disability. Another patient could barely get about before the fracture occurred because of crippling osteoarthritis of her knees, feet and hands. Excellent healing occurred but she could not make much use of the good result because of the arthritis. The broken nail was left *in situ;* as a result healing occurred with coxa vara. Previously he had had hemiplegia on the fractured side and got along poorly before and after healing.

CONCLUSION

1. The author agrees with Cleveland, Bosworth and Thompson that these patients in spite of their age and poor physical conditions, withstand anesthesia and surgery suprisingly well.

2. Reduction and nailing have greatly improved the general well-being of the patient and reduced the postoperative care to a minimum.

3. The mortality rate is lower. In this small series we were fortunate in having no deaths.

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CONGENITAL COXA VARA

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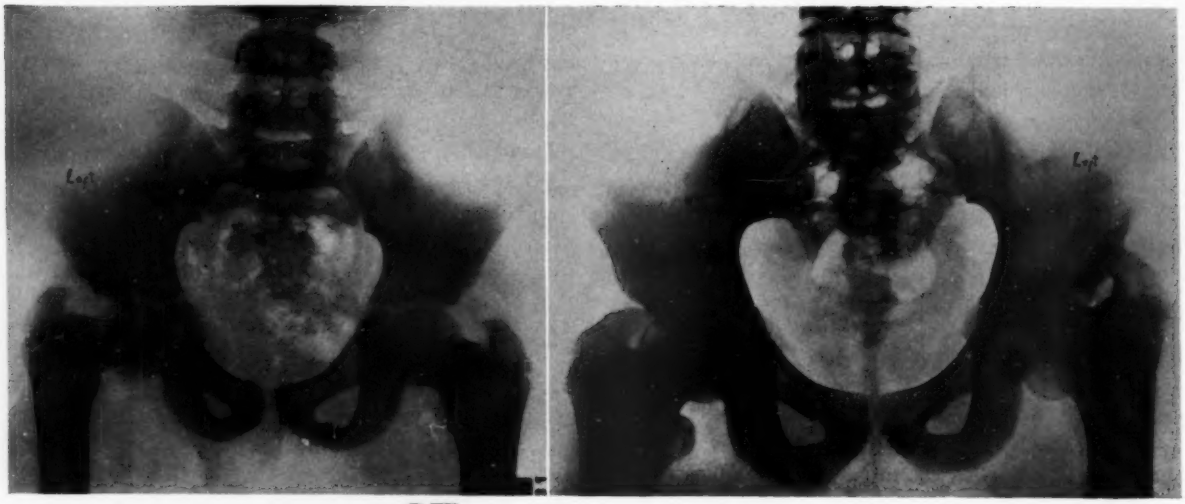
CONGENITAL coxa vara, a condition in which the neck of the femur forms a more acute angle with the shaft than normally, was known by various names until 1894 when Hofmeister coined the term which persists to this day. The types of coxa vara are numerous but the group with which this paper is concerned has the following characteristics: (1) vertical instead of horizontal epiphyseal line; (2) a triangular, apparently free fragment of bone in the neck; (3) pointed trochanter and (4) a notch in the ilium just above the acetabulum. This syndrome is known as congenital coxa vara to most authors. Camitz,[1] Schwartz and others believe that it should be known as infantile coxa vara as their studies make them believe that this condition is a developmental variation similar to Legg-Perthes disease.

The literature is summarized by Zadek.[2] There is one article that might be added to his summary, namely, that of Armstrong[3] who attempts to give an explanation for the triangular fragment of bone in the neck. His explanation takes into account the theory of Walmsley who states that in infancy the head of the femur sits on top of the shaft. At about the age of five and a half years the head tilts medially and a medial process which eventually becomes the neck is developed to support the inclining head. Armstrong theorized that if this medial process should not completely develop or if it should fail to fuse with the shaft, a coxa vara could result. He has a group of illustrations which effectively help visualize his theory.

Pathology. As revealed in the roentgenogram the most striking feature is the peculiarity of the neck of the femur. It is depressed (varus), thin and irregular as if there was a loss of substance making it appear dwarfed in comparison to the head. Hoffa states that the epiphyseal line is vertical instead of in the horizontal plane. However, in some x-rays an epiphyseal line is not discernible. The cartilage cells which normally form this line are in these cases irregularly arranged. The greater this dyscrasia is, the thinner and weaker the neck is and the more susceptible it becomes to progressive varus deformity. If a line does appear, it is because the shearing stresses are greater than the tissues can resist. The line when present is vertical and is a manifestation of crystalization of the stresses which cause a zone of rarefaction. This is in accordance with the law of Roux which states that if the stresses are excessive the tissues respond with atrophy instead of hypertrophy. This is where the pseudo-arthrosis develops. This area of rarefaction may be mistaken for an epiphyseal line. Schwartz also states that there is no upper femoral epiphysis. Quite frequently an apparently free, triangular piece of bone is distinguishable. It may be either in the superior or inferior quadrant of the neck. Armstrong and others state that it is in the inferior part of the neck and gives the appearance of an inverted Y. In the right hip of Figures 1A and 2A the Y is upright while in the left neck of Figure 2A it is inverted. With this apparent variability it could hardly be a congenital defect. Some authors call them artifacts. Might they not be incomplete fractures? The pseudo-arthrosis develops at these lines. In Figure 2, showing the right hip, the trochanters are pointed and beak-like. Figures 1A, B and C show this in the extreme. The trochanters may bend inward enough to cause a hollowing of the ilium just above the acetabulum. (Fig. 1B.) This patient was a ten year old boy who presented himself to the clinic because of peculiar looking hips. A limp had been present as long as he could remember.

Symptoms. In the orthopedic clinic of the University of Illinois, College of Medicine, eighteen or more patients have been under observation, of which only sixteen accepted treatment. Their ages varied from five weeks to sixteen years of age. One patient was five; three, seven; two, eight; one, nine; one, ten; one, twelve; one, fourteen; three, fifteen and



1A 1B

1C

FIG. 1. A, examination showed some limitation of abduction of the left hip. Both trochanters are beaked. The left ilium definitely has a notch above the acetabulum and the left neck is thin and shows irregular ossification near the head which runs vertically and is not cleancut as an epiphysis should be, and looks somewhat like an inverted Y. The disturbance in the right neck is not marked; B, taken six years later when the patient returned because of marked limitation of abduction. The angle of the neck with the shaft is about 95 degrees. The dyscrasia in the neck is moderate. The neck was able to withstand the stress and went on to ossification; C, an osteotomy was done to bring the trochanter away from the ilium to improve abduction. A good range of motion developed.

two, sixteen. The five week old baby was brought in because of a malunited birth fracture and while under observation it was noted that a coxa vara was developing.

The presenting complaint in the majority of cases was a painless limp while two patients were aware of a deformed appearance of the hip. One parent noted that the hips in one child seemed peculiar from the age of two and progressed so that the patient did not begin to walk until five years of age. Many authors stress that these patients walk late; however, others, believe that the symptoms begin in adolescence. In our series the patients complained shortly after the periods which are recognized as stages of rapid growth (i.e., six and twelve) and the duration of symptoms before seeking advice was between one and two and a half years.

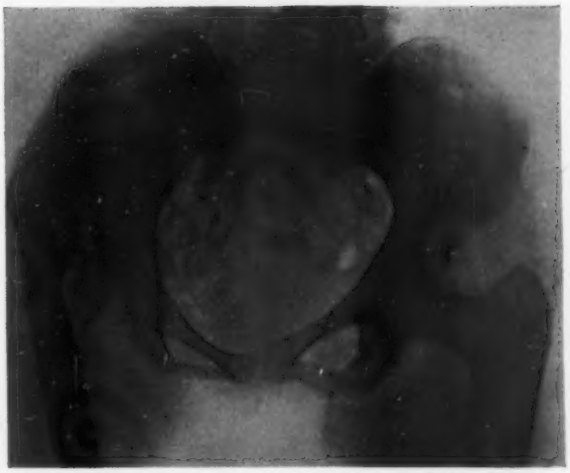
Pain is reported as beginning in late adolescence but one patient in the survey complained that his hip was painful. This boy, sixteen years of age, came to the clinic because of a limp and pain in the left hip and back of

the knee if he walked too much. The limp was noticed for three years. At the age of ten "he fell from a moving truck and was knocked out but had no symptoms at the time" nor did he limp. The patient walked with a slight limp and presented a good range of motion. (Fig. 3.) The other patients said they sought medical attention only because of inability to use the extremity normally. This disability is the result of the cartilaginous zone going on to non-union instead of ossifying. Three of our cases followed this course. One patient was seen at the age of seven (Fig. 2) but treatment was refused until the age of eighteen. This patient, a girl, came to the clinic because of a peculiar gait of one year's duration. Two other patients were observed at an early age but also refused treatment. They returned after pseudo-arthrosis had developed and again refused treatment. A fourth case was observed with an early stage of pseudo-arthrosis. (Fig. 4.) This patient was nine years of age. The admitting complaint was limp of two years' duration which was intermittent at first. There was no injury and no pain.

Physical Findings. On examination the patient reveals the cardinal signs of coxa vara: (1) limp, (2) elevation of the greater trochanter above Rose-Nélaton line and (3) limitation of abduction and inward rotation. The Trendelenburg sign is positive. In the cases with both hips involved there was an increase of the lumbar lordosis. Shortening varied from ¾ to 1¼ inch and increased to 2¼ inches after the non-union (pseudo-arthrosis) in the neck developed.

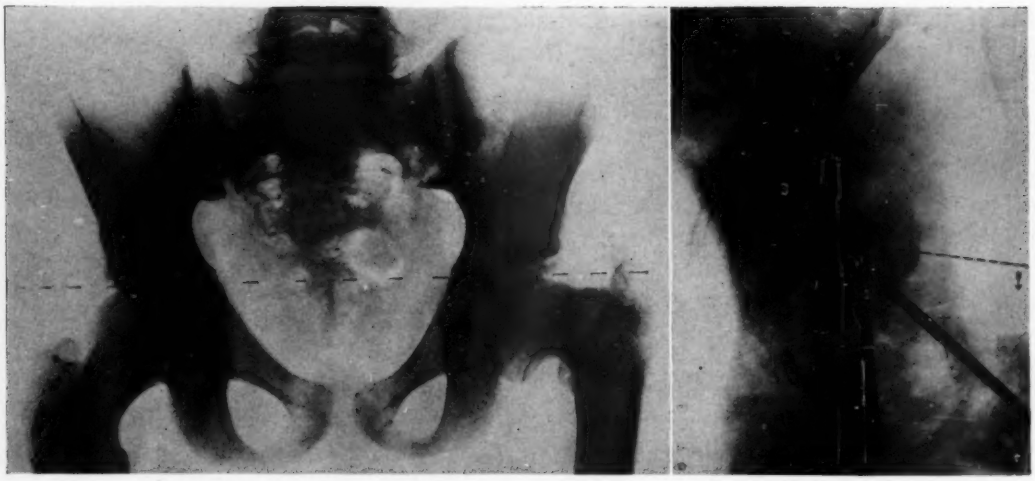
Prognosis. The prognosis depends upon what happens in the neck of the femur. If the defective ossification is mild and the bone goes on to solidification, the patient will have no complaints, e.g., the left hip in Case three and both hips in Case two. Unfortunately this is not the usual sequence. Zadek gives the impression that ossification will not occur spontaneously and that bone grafting for the neck is an absolute necessity. It is the author's opinion that the defect will go on to fusion if the angle of stress is changed. The law of Roux states that if the shearing and distraction stresses are too great bone responds with absorption rather than with hypertrophy. This series of cases would lead one to believe that if the angle of the neck of the femur with the shaft is greater than 90 degrees, the dyscrasia

2A

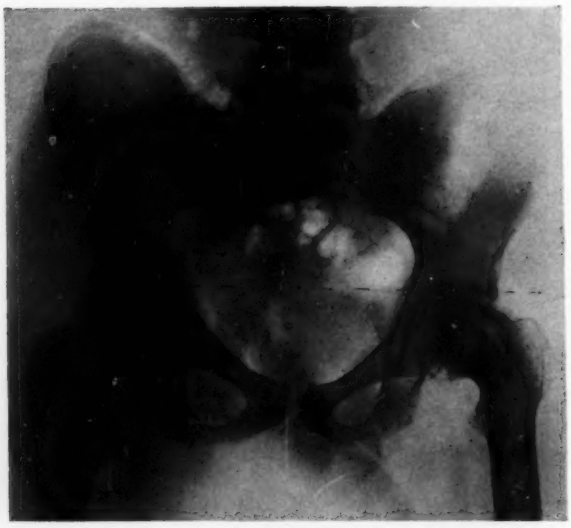


2B

FIG. 2. A, there was 1¼ inch shortening. The three cardinal points of coxa vara can be discerned in both hips. The stress line in the left hip is quite suggestive of an incomplete fracture. This is the only femoral head in the series that showed what might be called an epiphyseal line. Note that it is horizontal but that the stress line is vertical; B, eleven years later; the right hip has become a non-union. The left has completed ossification without treatment even though ossification was almost as defective, but the coxa vara is considerably less; hence the shearing stress was less (so much so that Wolf's law rather than Roux's was effective). It would seem logical that this determines whether ossification or non-union will ensue. A Whitman reconstruction was done on this patient at the age of eighteen. It was a difficult reconstruction, practically impossible to mobilize the trochanter. The hip was put up in balanced traction at the usual time (one month postoperatively). In the course of time there were a couple of manipulations under anesthesia. Three and a half years later the hip was stiff. There were no complaints as the patient had stability. X-ray was not photographed as it looks just like Figure 4B.



3A 3B



3C

FIG. 3. A, x-rays are those of a boy sixteen years of age; left trochanter was prominent and higher than the right one. There was 1½ inch shortening; B, after a cuneiform osteotomy was performed; the wire holding the upper fragment was driven in farther than necessary. The dotted line represents a better position. This patient has 10 degrees of flexion and 10 degrees of abduction and adduction. This stiffness could be due to the pressure of the wire breaking the cortex of the head superiorly at (3); C, taken about two years later shows roughening of the head superiorly at the weight-bearing area. The neck is completely ossified. The trochanter is 9/16 inch below the Y line and was 7/16 inch above it before osteotomy. This is the only one of the osteotomies which does not have a full range of flexion and extension.

will go on to fusion. If the angle is more acute than 90 degrees pseudo-arthrosis will develop.

Treatment. This can be divided into the treatment of the early cases (before pseudo-arthrosis develops) and the late or neglected cases (pseudo-arthrosis). The object of treatment in the early cases is to encourage ossification of the cartilaginous rest in the neck of the femur and to decrease the coxa vara.

All authors mention casts and braces only to condemn them. The writer has had no experience in casting cases of coxa vara. The ideal treatment is one that prevents shearing and distracting stresses in the cartilaginous neck so that it will heal and not go on to pseudo-arthrosis. The purpose of the cast or brace should not be for immobilization but rather to prevent weight-bearing. Chandler[4] holds the view that non-weight-bearing femoral necks develop a coxa valga, a feature which is highly desirable. To do so requires a period of years.

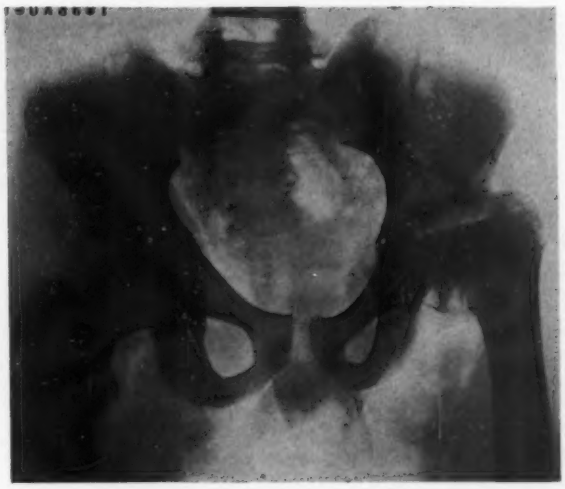
The patients with coxa vara who refuse surgery should be given the following opportunity for treatment: Have the patient use crutches and put a 3-inch extension under the shoe of the well leg. The purpose of the lift under the shoe is to get the patient further off the ground so that he will be less likely to bear weight on the diseased extremity. Drilling has been recommended in many conditions to hasten ossification. In one case in this series drilling was done but the result of the procedure is not known because the patient was not observed for a long enough period. If one should choose to drill the neck, this procedure

should be combined with the non-weight-bearing treatment as described.

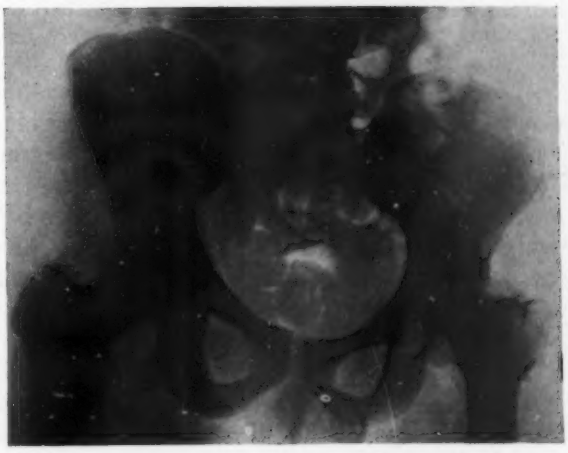
In the other early cases in this series the patients were treated surgically. This form of therapy was chosen because, as has already been stated, the ultimate goal of treatment is ossification of the neck as well as to decrease the coxa vara. Zadek maintained that each defect should be treated individually and recommended that a bone graft should be placed through the neck into the head and a subtrochanteric osteotomy performed to decrease the coxa vara. Correction of the coxa vara has sufficed in this series. The neck has always gone on to solidification because the osteotomy changes the stress or shearing force into a compression force as brought out by Pauwel.[7]

Simple osteotomies have been done on twelve hips with congenital coxa vara. (Fig. 5.) In the earlier cases osteotomies were simply performed just below the neck, the leg abducted and a cast applied. It was found to be difficult to obtain enough correction with this technic because there is no absolute control of the proximal fragment. Correction cannot be accomplished with this method until the trochanter impinges against the ilium. When this occurs the adductors become taut and further abduction is impossible without displacing the fragments. As a result the coxa vara is only partially corrected. (Fig. 1C.) To obviate these difficulties a cuneiform osteotomy with a wire to control the upper fragment was used.

Technic. The shaft of the femur is exposed through an anterior incision just below the base of the neck and a curved type of osteotomy is performed with the convexity upward, leaving a long point (at point 1) in the upper fragment as seen in Figure 3B. This will prevent displacement of the shaft as illustrated in Figure 1C. Gliding at the osteotomy site is facilitated if spicule labeled 2 in Figure 3B is removed. Just before the osteotomy is completed a ⅜ inch steel wire is introduced into the upper fragment (greater trochanter into neck of femur) through a stab wound over the lateral surface of the thigh. There is a tendency to introduce the wire as was done in this case. (Fig. 3D.) The course of the wire as indicated by the broken line is the better one as it is not as likely to break through the cortex of the head as illustrated in 3 of Figure 3B. The leg is abducted and downward pressure is applied to the wire. This keeps the trochanter from riding up against the ilium and the abduction obtained is greater. The free end of the pin is imbedded in the plaster cast. The advisability of this may be questioned; nevertheless, there were no infections in this series.



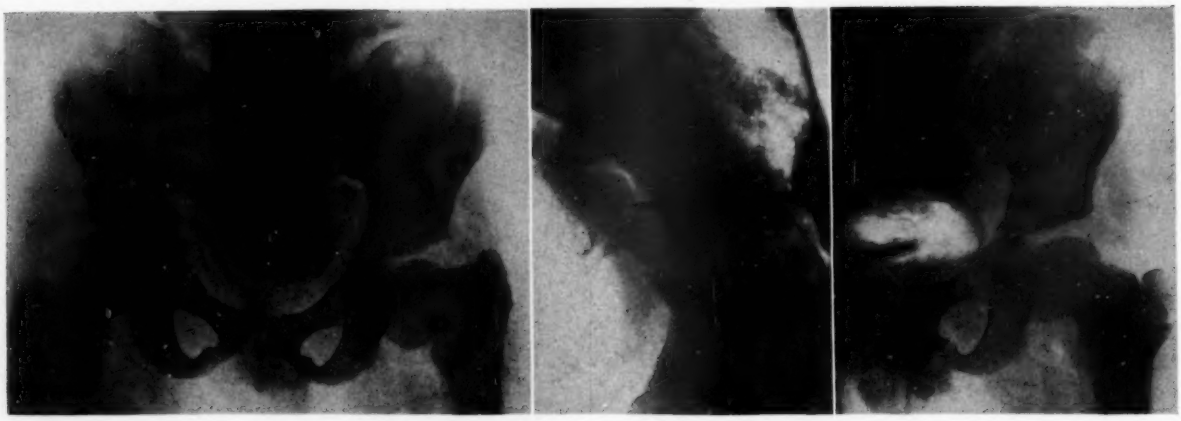
4A



4B

FIG. 4 A, abduction of the left hip limited; leg held in outward rotation; trochanter above Nelaton's line. The patient walks with a marked limp. There is coxa vara of less than 90 degrees and the head is even lower. This patient returned five years later with a pseudo-arthrosis; B, shows the end result of the Whitman procedure. There was active flexion of 25 degrees, 15 degrees of abduction.

In the advanced cases the Whitman reconstruction operation was performed, three being in two cases with the pseudo-arthrosis just completed (Fig. 4) and two in which the heads were quite displaced on the neck. (Fig. 2.) The author's experience with Whitman reconstruc-



5A 5B 5C

FIG. 5. X-rays of a boy seven years of age who had no complaint except shortening of his left leg. He presented a slight limp, ¾ inch shortening, flexion 90 per cent of normal, abduction 75 per cent of normal. X-ray shows coxa vara of 90 degrees with a beginning displacement of the head; B, x-ray shortly after the osteotomy; C, shows healed osteotomy with a good angle of neck of femur with the shaft. This cartilage area had completely ossified four months after osteotomy. None of the patients had x-rays taken at frequent intervals which would help in determining the average time required after osteotomy for ossification. Two years after osteotomy this hip presented a full range of motion. There was no limp.

tions in adolescents have been discouraging. None of the cases reported had over 25-degree flexion and one hip was quite stiff with only a few degrees passive motion. (Fig. 2.) Zaremba[5] prefers the reconstruction operation to the osteotomy. However, his illustrations are all of the pseudo-arthrosis or late type.

SUMMARY

Congenital or infantile coxa vara is a condition of the neck of the femur in which there is retardation of ossification resulting in the typical deformity. This condition gives rise to an uncertain prognosis. Ossification can be encouraged by decreasing the coxa vara by doing an osteotomy. In the event of complete disability because of pseudo-arthrosis and nonunion as seen in late and neglected cases stability can be re-established with a Whitman reconstruction operation even though the function of the hip joint is impaired.

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LYMPHOMAS OF THE ANORECTUM*

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DISCRETE tumors consisting largely of lymphoid tissue occurring in the distal rectum or anus are being reported in the literature with increasing frequency. (Table 1.) In this communication seven cases of solitary lymphoid tumors collectively termed lymphomas originating in the sphincteric rectum or anus are added. It is probable that these lesions are relatively common but are being excised and wrongly diagnosed as simple adenomas, papillitis and even hemorrhoids because of the lack of careful examination by competent pathologists.

McCarthy[1] stated that "the term lymphoma should be reserved for all visible and palpable enlargements of lymph nodes or follicles. If this definition be accepted a lymphoma may be inflammatory or neoplastic." Simple lymphoma was defined by Ewing as a local or regional, circumscribed, chronic enlargement of lymph nodes which is self-limiting and does not lead to systemic invasion.[2] In the gastrointestinal tract these benign tumors are uncommon. Malignant lymphoma occurs in the gastrointestinal tract as lymphosarcoma and is rather common. Ewing divides these into two types on a histologic basis, namely, (1) malignant lymphocytoma (small round cell sarcoma) and (2) reticulum cell sarcoma (large round cell sarcoma). In the first type the predominant cell is the small immature lymphocyte or lymphoblast. These cells proliferate to the exclusion of other cells and reticular elements invading even the capsule of the node and adjacent structures. In the second group, the reticulum cell sarcoma, the predominant cell is the reticulum cell, a large pale cell with a vesicular nucleus which may be round, oval or crescent-shaped. The cytoplasm is acidophilic and considerable in amount. Invasiveness is common and extreme.[3] Other types histologically described as follicular lymphoblastoma and a mixed cell type, the polymorphocellular sarcoma, are infrequently encountered.

Lymphoid tumors of the colon are relatively common. Hayes and associates[4] in 1939 collected 371 solitary lymphoid tumors of the colon, 341 of which were lymphosarcomas. The writers list cases reported by numerous authors of lymphosarcoma involving the sigmoid and ampullary rectum. Usher and Dixon[5] reported ten lymphosarcomas of the rectum in a series of fifty cases involving the small and large intestine. McSwain and Beal[6] found twenty cases of lymphosarcoma involving some part of the gastrointestinal tract in 149,469 hospital admissions between 1933 and 1942. Of these, three occurred in the anorectum. Li[7] reported twenty-six cases of simple benign lymphomas of the rectum over a twenty-seven-year period. Lymphomas apparently occur infrequently in the anorectal region. A comprehensive search of the literature for the past fifteen years reveals reports of only thirty-three such cases. This report is limited to a consideration of solitary lymphoid tumors arising in the anorectum. We define this region to include the anus and the sphincteric rectum. Gorsch[8] defines the sphincteric rectum as that area which extends cephalad 5 cm. from the anorectal (dentate) line to the insertion of the levators.

The physical characteristics of anorectal lymphomas are such that they are grossly difficult to distinguish from adenomatous polyps, hemorrhoids, hypertrophied papillas, foreign body granulomas and other benign lesions encountered in this region. Smith[9] reported three cases of primary lymphoid tumors resembling hemorrhoids and could find no other similar cases in the literature. In discussing Smith's paper Rosser emphasized the fact that lymphoid tumors of the rectum vary greatly in appearance and structure so that an accurate clinical diagnosis of the lesion is difficult. In fact, in none of the thirty-three reported cases (Table 1) was the lymphoid nature of the tumor established clinically. The diagnosis of lymphoma was made only after tissue examination by the pathologist.

Malignancies of the anorectum have been found repeatedly by the pathologist after

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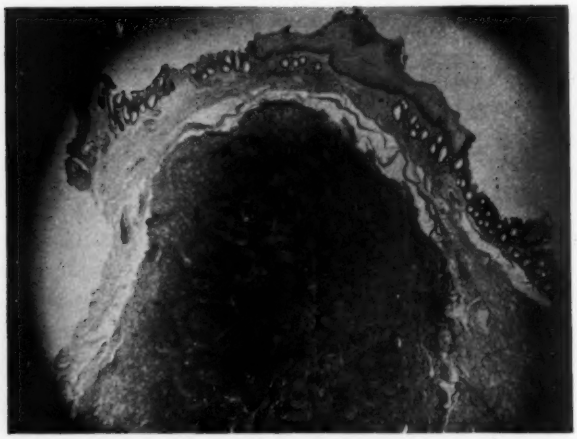

FIG. 1. Case I. Simple benign lymphoma; squamous epithelium and rectal glands at the anorectal junction overlying lymphoid tumor the germinal follicles of which are well differentiated.

examination of purportedly benign anorectal lesions such as fistulas, hemorrhoids, papillitis, fissures and other local lesions. Smith[10] collected 116 cases of malignancy associated with such anorectal diseases. The evidence is convincing that notwithstanding obvious benignancy, it is mandatory on the part of the surgeon to submit all excised anorectal lesions to the pathologist for careful microscopic examination. Only the pathologist can establish the malignant nature or potentialities of these lymphomas. The importance of this information regarding the necessity for postoperative irradiation is obvious. Eight cases of solitary tumors consisting largely of lymphoid tissue and originating in the anorectum not previously reported have recently come under our observation.

CASE REPORTS

CASE I. A male, aged thirty, complained of soreness and protrusion of a mass with defecation. A polypoid tumor 1½ by 1 by 1 cm. on the anterior rectal wall 1 cm. above the anorectal junction was found and excised. On section a simple benign lymphoma was found. The patient has remained free of recurrence for seven years. (Fig. 1.)

CASE II. A male, aged thirty-seven, twin brother of patient in Case 1, was troubled with extrusion of a mass, anal discomfort and occasional bleeding with defecation. Two small, salmon colored submucous nodules and one sessile polyp 2 by 2 by 1 cm. were found lying close together just above the anorectal line. These were excised *en bloc* with adjacent mucosa and muscle. The lesion proved to be a benign lymphoma.

CASE III. This patient, a female, aged forty, had no rectal complaints. Three small submucous tumors just above the anorectal junction anteriorly were found during a routine physical examination. These were individually excised and proved to be simple benign lymphomas by the pathologist. Cases II and III occurred at about the same time; and because the tumors were small, discrete, submucous and salmon colored as seen through the anoscope, the clinical diagnosis of simple lymphoma was ventured.

TABLE I

LYMPHOMAS OF THE ANORECTUM (THIRTY-THREE REPORTED CASES)

Author	Location		Benign Simple Lymphomas	Malignant Lymphomas
	Anus	Rectum		
Smith, N. D.[13]	1	1	..	2
Dukes, C.[14]	..	3	3	..
Kleiner, S. B.[15]	1	..	..	1
Tucker, C. C. and Hellwig, C. H[16]	2	..	..	2
Hayes, H. T., Burr, H. B. and Pruit, L. T.[17]	..	1	1	..
Lynch, J. M. and Hamilton, G. J.[18]	..	3	..	3
Gruenwald, P.[19]	..	3	3	..
Tuta, J. A. and Rosi, P. A.[20]	..	1	..	1
Smith, T. E.[9]	3	..	2	1
Tucker, C. C.[21]	3	..	..	3
McSwain, B. and Beal, J. M[6]	..	3	..	3
Jackman, R. J.[22]	..	4	2	2
Shapiro, S. and Astracham, J. E.[23]	..	2	..	2
Manheim, S. D.[24]	..	2	..	2
Total	10	23	11	22

CASE IV. A male, aged thirty-two, complained of occasional bleeding with defecation and slight anal discomfort. A polypoid tumor mass on a short pedicle 2 by 1 by 1 cm. in size was found on the left lateral wall of the rectum 4 cm. above the anorectal junction. Examination after wide excision showed this to consist of a polyp containing a solitary benign lymphoma.

FIG. 2. Case v. Giant follicle lymphoblastoma; rectal mucosa is compressed and eroded by encroaching lymphoid tumor mass. The discrete architecture of the follicles is no longer apparent because their limiting margins have been overrun.

CASE V.* This patient, a male, aged thirty-eight, had been troubled with increasing constipation, occasional bleeding with defecation and sense of discomfort in the anal region for about six months. A polypoid tumor mass on a short pedicle 2 by 2 by 2 cm. with two small, submucous adjacent nodules were removed with cautery snare. The pathologist reported that the polyp consisted of a solitary mass of lymphoid tissue made up of giant follicles compressing the mucosa and eroding it at one point. The cellular structure was made up of lymphoblasts with some anaplasia and an occasional mitotic figure. The picture was typical of giant follicle lymphoblastoma. Follow-up examination eighteen months after operation revealed no local or distant spread of the lesion. (Fig. 2.)

CASE VI. A female, aged thirty, had a chronic perianal fistula of the right posterior quadrant excised elsewhere. This healed uneventfully. Five months later she complained of a sense of fullness in the anus and increasing constipation. A firm, discrete, submucous tumor mass, 3 by 2 by 1 cm. in size was found in the right lateral quadrant of the anal canal. This lesion was widely excised. Pathologic examination showed that the lesion consisted of a mass of submucous lymphoid tissue containing a number of discrete tubercles typical of Boeck's sarcoid. (Fig. 3.) Cystic changes were subsequently found by x-ray in the bones of the left hand and roentgenography of the lungs showed lesions typical of the disease.

* We are indebted to Dr. T. J. Galvin for permission to present Case v.

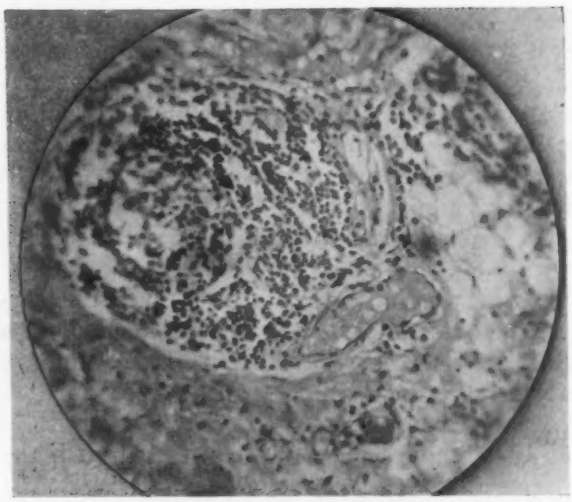

FIG. 3. Case VI. Tubercle formation typical of Boeck's sarcoid; absence of central necrosis, plasma cells and discrete architecture differentiates this lesion from tuberculous granulation tissue.

CASE VII. A Negro male, aged thirty-three, complained of protruding, bleeding hemorrhoids. At the time of hemorrhoidectomy an associated polyp assumed to be a hypertrophied papilla was likewise excised. Microscopic examination of the polyp showed wide submucous infiltration with lymphocytes. Infiltrating the lymphoid hyperplasia were noted large polyhedral cells with hyperchromatic nuclei suggestive of non-pigmented malignant melanoma. Despite radiation therapy locally, generalized metastasis rapidly ensued and the patient died within eight months of operation.

Although the lesion was not a true lymphoma, this case was included because of its unusual interest. It is probable that in this patient the sarcomatous melanoma cells invaded the hypertrophic lymphoid mass from their origin in anal skin. Melanomas are said by some pathologists to be neurogenous tumors as they arise in the distorted tactile corpuscles of the skin, the so-called Hassall's Bodies. In the intestinal tract they could not be expected to occur except in one situation, the anal canal which develops from the ectoderm. According to Foot[11] they occupy the region of the pectinate line and may be mistaken for thrombosed hemorrhoids. A further interesting point is that malignant melanomas are extremely rare in the American Negro.

CASE VIII. A male, aged twenty-eight, complained of persistent pain and drainage of pus following operation for "piles" performed elsewhere three months previously. A nodular

mass 3 by 2 by 2 cm. with central ulceration was found in the left anterior quadrant at the anorectal margin. Following biopsy the pathologist reported lymphosarcoma, reticulum cell type, with marked anaplasia, numerous mitotic figures and wide invasiveness. Generalized lymphadenopathy was already present and increased slowly until the patient's death within a year of the primary operation.

Ewing[3] claimed that in reticulum cell sarcoma the primary lesion has a tendency to localize in the organ of origin. Early excision and irradiation may control the disease. However, other observers claim that in practically all cases the lesion again manifests itself if the patient is followed up long enough.

COMMENT

The biologic cause providing the stimulus for and the subsequent overgrowth of lymphoid cells to result in lymphoid tumors is unknown. Certain pertinent related factors are worthy of consideration. According to Ewing, pathologists for many years have expressed the belief that lymphosarcomas are not true tumors but require separate positions among pathologic processes. They find that this process is so intimately connected with and dependent upon infection and intrinsic irritation and presents so many features of an inflammatory process that it may not be given a definite place among strictly autonomous neoplasms. When applied specifically to the anorectum the work of Dukes and Bussey[12] is significant. They showed that lymphoid follicles are numerous in the submucosa of the distal colon, averaging about four to the square centimeter. The lymph follicles penetrate the muscularis mucosa thereby affording direct access to the lumen of the bowel. In the anorectal region the lymphoid follicle is thus exposed to irritants consisting of pathogens present in the feces, the high alkalinity (pH 8 to pH 10) normally present in the rectum and the constant trauma of the act of defecation. These factors may have considerable significance when applied to a consideration of the genesis of anorectal lymphomas.

SUMMARY

Lymphomas are solitary tumors consisting largely of lymphoid tissue and may be benign or malignant. Their characteristics and morphology have been described.

Lymphomas of the anorectum are uncommon. Only thirty-three such cases have been reported in the last fifteen years. It is probable that many lymphomas of the anorectum are missed because of neglect on the part of surgeons to insist on careful pathologic examination of all tissue excised from the anorectum.

Eight cases are reported. Four were simple benign lymphomas, one giant follicle lymphoblastoma, a reticulum cell sarcoma and Boeck's sarcoid were described. A primary malignant melanoma invading a hyperplastic lymph follicle was included although this is not a true lymphoma. All cases originated in the anorectum, seven lesions of which were true lymphomas.

A consideration of factors involved in the etiology of these lesions as they specifically pertain to the anorectum is discussed.

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Leriche treated almost 150 patients with arteritis obliterans with arteriectomy of the superficial or deep femoral artery (in 112 cases), of the external iliac artery (in seventeen cases), the popliteal (in fifteen cases), the posterior tibial (in seven cases), the subclavian, axillary and humeral artery (in eighteen cases) and the aorta (in two cases). Satisfactory or permanent results were obtained in about half of the cases but secondary amputation was required in over one-fourth of all these patients, usually as the result of a dry gangrene which occurred quickly in most of the latter. In spite of a moderately high mortality, Leriche believes arteriectomy is a worth while procedure in many of these cases since it checks the progress of the thrombosis present. He believes arteriography may be of great help in enabling the surgeon to decide whether to do an amputation or an arteriectomy in any given case. Occasionally lumbar ganglionectomy may be combined with arteriectomy to improve the ultimate results and produce more favorable changes in the peripheral circulation, providing the patient is able to withstand the additional surgical shock or trauma of this second operation. (*Richard A. Leonardo, M.D.*)

DIAGNOSIS OF CANCER OF THE RECTUM BY CYTOLOGY*

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A STUDY of cells desquamated from human tissues wherever accessible has resulted in promising findings relative to the diagnosis of malignancy in these tissues. Papanicolaou[1] has described numerous technics relating to the diagnosis of malignancy in the uterus, cancer of the lungs, stomach, bladder, etc. There are numerous obstacles, however, which tend to make investigation of tissues of the rectum which may be accessible difficult, but which, on the other hand, may not always be studied because of the function of the bowels rendering this difficult or impossible.

A case is reported herein, however, in which a technic has been followed which has permitted the identification of cancer cells from a rectal polypoid growth, palpable by digital examination. This patient, aged sixty-six, had spent three years in Hongkong as a prisoner of war. She presented herself for examination with a complaint of alternating constipation and diarrhea, and bleeding from hemorrhoids. She stated she had been troubled with this dysenteric disorder while in the East. Having a fear of cancer, she had a careful examination nine months previous to this and had had a barium enema with a negative result. The patient presented herself largely because she wanted a cytologic test of the cervix to rule out malignancy. This was taken and proved negative. At the time of the initial examination the usual digital examination of the rectum was done with negative findings. When the second visit was made, however, a combined vaginal-rectal examination was done and a polypoid growth was detected high up in the rectum. A cytologic test was taken from this growth by a technic which will be described later. A moderately profuse amount of blood and some fecal matter was removed when the test was taken. Microscopic examination of the cells following staining of the cytologic smear revealed glandular cells of a malignant type. A diagnosis of carcinoma of the rectum was made on the basis of these cells and the clinical findings. The patient was referred to the Royal Victoria Hospital and, following surgical extirpation, the nature of the lesion was confirmed as adenocarcinoma of the rectum. (Fig. 1.)

TECHNIC

The bowel function makes it difficult to obtain cellular material which will be sufficiently free of fecal matter for investigation. The following technic is advised: The patient should have an enema preceding the visit to the office. In the case of a female patient a combined vaginal-rectal examination is done. The detection of this type of growth, of course, is dependent upon a palpable lesion; but if the finger may reach the growth, it should be accessible to obtain cells from it for examination. While the two fingers were still in the vaginal and rectal orifices and the middle finger in contact with the growth, extra lubricant was applied around the anal orifice and a pipette was pushed along gently, guided with the gloved finger. As the pipette passed up the rectum, slight pressure on the attached rubber bulb was increased; hence no fecal matter blocked the lumen of the pipette. Then, as the pipette reached the mass palpated by the finger, a further expulsion of air was made from the bulb to free the opening of the pipette which was then placed in contact with the rectal tumor. The bulb was released and the pipette was filled with a considerable amount of bloody material. The pipette was then withdrawn, and the examining finger was placed over the opening of the pipette during withdrawal to prevent further contamination with fecal matter. Several smears were made from the bloody secretion in the pipette and study of these revealed clear-cut staining of cells exhibiting the morphologic characteristics of malignancy.

* From the Cytologic Laboratories, Donner Building for Medical Research, McGill University, and the Gynecytology Laboratory, Royal Victoria Hospital, McGill University, Montreal, Can. This work was supported by funds donated by Mrs. Walter M. Stewart, Montreal, Can.

COMMENT

The value of this cytologic technic in cancer of the rectum in diagnosis is questionable. Undoubtedly, it cannot be hoped that it will render the same great function in the detection of the very early preclinical cancer which is shown to be possible by cervical "surface-biopsy"[2] scraping in detection of early cervical carcinoma. Such an early diagnosis means that these patients are able to be treated and are curable in a high percentage of cases. Therefore, the diagnosis performed a tremendously important function preceding routine treatment. On the other hand, in cancer of the rectum, obviously there must be a palpable lesion before the test would come into play. This implies, of course, that the lesion would not usually be early and any lesion which the finger could feel in the rectum should be subjected to further diagnostic investigation and to treatment in any case. Therefore, the finding of cells from a tumor of this sort is, perhaps, more of incidental interest than of practical value in diagnosis. On the other hand, it is at least interesting that cells may be obtained which would give quick confirmation following the initial visit of the patient to the surgeon's office, later to be verified, of course, when the patient is hospitalized and has x-ray confirmation of the lesion. Microscopic confirmation by simple cytologic test or by biopsy is essential over and above an x-ray report to determine the actual nature of the growth. Once the lesion is established as a carcinoma, it is possible to proceed with further therapy with a minimal amount of delay or preliminary surgical interference. It is suggested that further study of "surface-biopsy" cell scrapings of rectal growths visualized by sigmoidoscopy and other endoscopic examinations may prove more worth while and of some practical value.

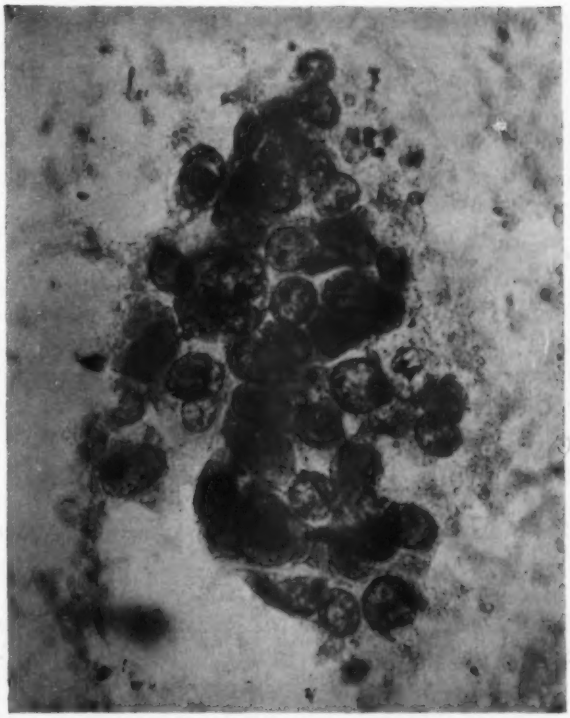

FIG. 1. Group of glandular carcinoma cells from rectal polyp; biopsy of tissue postoperatively confirmed lesion as adenocarcinoma.

SUMMARY

A technic is described in which cells were obtained from a rectal growth, enabling confirmation of lesion as carcinoma. The finding of cells in this case was of incidental rather than practical value.

The examination of "surface-biopsy" cell scrapings of rectal lesions visualized during sigmoidoscopy, etc., offers a potentially practical aid to diagnosis.

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CARCINOMA OF THE COLON AND RECTUM*

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THIS report is a clinical study of 502 patients with carcinoma of either the colon or rectum admitted to University Hospitals of Cleveland during a ten-year period from October, 1935, to September, 1945. Because 71.3 per cent of the patients were cared for by private surgeons, an impossible follow-up study prohibits the inclusion of a disease mortality rate or a satisfactory five-year cure rate. For the most part the statistics are divided into two five-year periods, namely, the first from 1935 to 1940, and the second from 1940 to 1945.

The average age of the 502 patients in the series was 58.2 years (59.2 in the recent five-year period and 57.2 in the earlier period). The youngest patient was twenty-seven and the oldest ninety-two. The oldest patient subjected to operation was eighty-one. More than one-half or 58.5 per cent of the patients were in their sixth and seventh decades. The sexes were practically equally divided in each five-year period.

SYMPTOMS

There is little to add to the classic description of the symptoms encountered in carcinoma of the colon. Constipation, diarrhea, abdominal pain or colic, melena, weakness, vomiting, palpation of a mass, or some combination of these were the first manifestations of large bowel neoplasm in 95 per cent of the patients. Symptoms could be traced back in the history an average of 9.5 months before the patient was admitted to the hospital or before the diagnosis was established. In the earlier five-year period the average duration of symptoms was 10.7 months compared to 7.9 months for the second period. The difference suggests an increasing initiative on the part of the patients in seeking medical advice.

Constipation was the most common initial symptom and was present for the longest period prior to a radiographic or histologic diagnosis. Pain, the second most frequent symptom, permitted the earliest diagnoses. Ten of the patients whose first symptom was a palpable mass in the abdomen waited an average of 9.6 months before consulting a physician. In eight of these cases at the time of admission no other symptoms had developed. Palpation of a mass should not lead the surgeon to expect an extensive lymphatic spread of the neoplasm prohibiting resection. On the contrary, resectability in general is more frequent. Three patients entered the hospital with acute intestinal obstruction of twelve hours' duration. No previous symptoms could be elicited. Of 163 patients whose symptoms were of ten months' duration or more, only sixty-one or 38 per cent were considered hopeless or were subjected to a palliative procedure. The resectability rate, explained in detail hereafter, was 62 per cent in this group while the rate in the entire series was 50.4 per cent.

In order to make a diagnosis of carcinoma of the large intestine digital examination, proctoscopic observation and biopsy, and a barium enema outweigh the value of the most painstaking history and it will be only through the more frequent use of these procedures when symptoms first appear and persist, that earlier diagnoses will be made. Since 67 per cent of the lesions in this series were encountered in the sigmoid colon or rectum, the majority of the diagnoses in these patients can be made by digital or sigmoidoscopic examination. Furthermore, in these patients as well as the remaining 33 per cent barium enemas when performed failed to show radiographic evidence of a neoplasm in only seven instances. Four of the seven were rectal tumors. It follows that in carcinomatous growths of the colon and rectum of an average of 9.5 months' duration there is little opportunity to improve the percentage of accurate diagnoses. It is very likely, however, that radiographic examination would not be as accurate if 2.5 months had elapsed from the onset of symptoms instead of 9.5 months. With

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such accurate diagnostic methods available the opportunity for cure by resection can be improved only by bringing the patient to the physician earlier in the course of his disease. As far as could be determined the delay in diagnosis could not be attributed to the physician in most instances. Thirty-six of the 502 patients had been under the care of a physician for five months prior to admission. In some of these cases the diagnosis was not suspected; in others, however, radiographic or proctoscopic examination was refused.

TABLE 1
REGIONAL DISTRIBUTION OF CARCINOMA OF THE COLON AND RECTUM

Region	No. of Patients	Patients (Per cent)	No. of Patients Operated upon
Cecum	41	8.0	33
Ascending colon	32	6.4	26
Hepatic flexure	11	2.2	11
Transverse colon	37	7.4	33
Splenic flexure	15	3.0	14
Descending colon	32	6.4	30
Sigmoid	133	26.6	109
Rectum	201	40.0	145
Total	502	100.0	401

Patients must seek medical advice earlier if more of them are to have the opportunity of successful resections. Public education appears to be the only means available at the present time. If and when less expensive and less inconvenient methods of diagnosis are available, the problem of earlier diagnosis will be less difficult. Until that time radiographic examination is the single most important diagnostic facility that can be offered.

Region Involved. Division of the large intestine into regions was arbitrary. Regional distribution of carcinoma of the colon and rectum in this series of patients is indicated in Table 1. In the recent five-year period the diagnosis of rectal carcinoma was made less frequently while recognition of lesions of the sigmoid and rectosigmoid increased over the first five-year period. Lesions of the right colon were twice as common in patients operated upon from 1940 to 1945 as from 1935 to 1940.

Histologic diagnoses were available in 420 or 83.7 per cent of all admissions. Adenocarcinomas, variously differentiated, occurred in 75 per cent, and mucinous carcinomas in 17 per cent of the patients. Carcinoma simplex, squamous cell, papilliferous, and scirrhous carcinomas were identified in the remainder.

Two hundred fifty-three patients underwent operative resection, and histologic examination revealed lymph node metastases in 30.4 per cent of the specimens. Liver biopsy in 4.4 per cent of operated patients revealed metastases.

Erythrocyte Count. The average erythrocyte count on admission was 4,250,000. This was practically identical in the two five-year periods. The average count in carcinoma of the cecum was 3,800,000.

OPERATION

In this report the terms resection and anastomosis indicate that both procedures were carried out during the course of one operation, and preliminary or complemental colostomy does not alter the use of these terms.

Although not an uncommon operative procedure in the past thirty years, the procedure of resection and anastomosis, by which exteriorization of the colon is eliminated, has not been the treatment of choice. It is only within the past ten years that the advantage of primary resection and anastomosis has attracted the skilled and experienced surgeons. The earliest type of surgical treatment of carcinoma of the colon was of this nature. Before Paul and Mikulicz popularized the operation that now bears the latter's name, they and others were performing primary resection and anastomosis with a 30 to 50 per cent mortality rate. Following Mikulicz's original report in 1903 of a 12.5 per cent mortality rate in sixteen patients, exteriorization was promptly accepted. The Mikulicz procedure with minor modifications, although performed less and less frequently, has been one of the single major contributions to abdominal surgery.

Early failures in one-stage procedures with primary anastomosis were considered to be due to the contamination encountered in opening the intestinal tract, and efforts were instituted toward the development of an aseptic technic. In 1917, however, Lockart-Mummery proposed circulatory embarrassment at the anastomotic site as the cause of failure and devised a satisfactory end-to-end open anastomosis. He believed that an "aseptic anastomosis" was not in the true sense of the word aseptic and that

the slight contamination of the peritoneal cavity encountered in an open anastomosis was less dangerous than subsequent contamination at a point of necrosis in the suture line. With refinements in technic such as elimination of undue tension, removal of appendices epiploicae from the anastomotic site and preliminary colostomy more and more primary resections were performed, but they were still the exception rather than the rule until ten years ago.

The increasing popularity of resection and anastomosis of the colon during the past ten years may be due to the advent of intestinal intubation, transfusion, attention to fluid, electrolyte and protein metabolism, the use of chemotherapeutic and antibiotic drugs, aseptic anastomosis or perhaps refinement in operative technic in general; but if earlier statistics are accepted, it is probably a combination of these. Many of the reports on resection and anastomosis in the past were encouraging. It must be remembered, however, that when resection and anastomosis of the colon were reinstituted the patients who were generally poor risks were still subjected to a Mikulicz resection. Whipple in 1944 commented, "There are cases and conditions when the Mikulicz or preferably Rankin procedures are indicated but I am sure as time goes on the Mikulicz technique will be discarded." One of the objects in undertaking this review was to determine this trend away from exteriorization and to establish a control for future methods of surgical therapy.

In reviewing surgical papers on carcinoma of the colon and rectum there is some confusion of the terms operability and resectability so that it seems expedient to define these terms according to our own denotation. Operability rate signifies the percentage of all patients admitted with a radiographic or histologic diagnosis of cancer of the colon or rectum subjected to a laparotomy. Resectability rate signifies the percentage of patients admitted whose lesion is resected. Operative resectability rate is the percentage of patients operated upon whose lesion is resected. Mortality rates are likewise ambiguous since they may be based on total admissions, operated patients or those patients subjected to a particular type of operation. Unless total admissions with a diagnosis of cancer of the large intestine are considered, a true picture of what is happening to patients with the disease cannot be obtained. It is not at all unusual to see patients on the staff service who have been denied operation elsewhere and upon whom successful resections can be performed.

Operability Rate. Of 502 patients studied, 358 were private and 144 or 28.7 per cent staff patients. Four hundred one were treated surgically. The operability rate was 79.9 per cent.

TABLE II
ANNUAL DISTRIBUTION OF PATIENTS

Year	Total No. of Patients	Patients Operated upon	Patients Not Operated upon	Resections
1935	16	13	3	6
1936	32	23	9	13
1937	52	38	14	24
1938	49	42	7	22
1939	60	50	10	34
1940	66	53	13	32
1941	60	53	7	31
1942	42	30	12	24
1943	35	30	5	20
1944	59	43	16	29
1945	31	26	5	18
Total	502	401	101	253

On the 401 patients 453 major operative procedures were performed excluding closure of colostomies or operations necessitated by complications of the original procedures.

Resectability Rate. Resection of the tumor was performed upon 253 patients. The resectability rate was 50.4 per cent. The rate was 47.6 per cent for the first five-year period and 53.7 per cent for the second. Since 101 of the 502 patients received no operative treatment whatsoever, the operative resectability rate was 63.1 per cent. In the recent period this rate was 67 per cent; in the earlier period it was 59.7 per cent. An occasional patient, because of cardiovascular or respiratory complications, cannot be prepared for surgery. Some patients refuse operation. On the staff service of a municipal hospital patients are not infrequently admitted for terminal care. In a private institution these difficulties are not so apt to be encountered and the resectability rate is therefore higher. The annual distribution of operations and patients is shown in Table II.

A comparison of the two five-year periods shows that there was no appreciable difference in the number of admissions. There was an increase of 7.3 per cent in the operative resectability rate during the period from 1940 to 1945.

More radical surgery rather than a series of less extensive lesions was the basis for this increase.

Resection. Resection and anastomosis were performed in thirty of 131 resections from 1935 to 1940, while in the latter five-year period it was utilized in sixty-nine of 122 resections.

TABLE III
INCIDENCE OF RESECTION AND ANASTOMOSIS, MIKULICZ PROCEDURE AND COMBINED ABDOMINOPERINEAL RESECTION IN THE TWO PERIODS

Type of Operation	1935–1940	1940–1945
Resection and anastomosis....	30	69
End-to-end.....	16	33
Side-to-side.....	7	18
End-to-side.....	7	18
Mikulicz.....	45	15
Combined abdominoperineal..	56	38
Total.....253	131	122

Eighteen per cent of the anastomoses were aseptic and 82 per cent open. A complementary colostomy or ileostomy was performed in twenty-seven patients. Twenty-one of these were done since 1940. There were four two-stage procedures from 1940 to 1945 and ten from 1935 to 1940. Five of the primary resections were palliative, all performed since 1940. Table III shows the incidence of resection and anastomosis, Mikulicz procedure and combined abdominoperineal resection in the two periods. The growing disfavor of the Mikulicz procedure and adoption of primary resection and anastomosis are evident. The decrease in the number of combined abdominoperineal resections is more apparent than real because carcinoma of the rectum has been more accurately differentiated from carcinoma of the lower sigmoid since 1940 and primary anastomosis rather than combined resection has been used more frequently for the latter lesion.

Mortality Rates. Every patient failing to leave the hospital alive, regardless of the time elapsed following operation, has been included in the mortality statistics. Of 502 patients, 113 hospital deaths were recorded, giving an overall mortality rate of 22.5 per cent. Of the 401 patients subjected to some form of surgery, there were eighty-eight deaths or an operative mortality rate of 21.9 per cent. One of five patients admitted will not be operated upon, while one of every five who are surgically treated will succumb during the postoperative period. Of the 253 patients who underwent a resection of the large intestine, fifty-six or 22.2 per cent died. Table IV shows the operative mortality rate of patients who were subjected to resection of the large intestine in the two periods. The

TABLE IV
OPERATIVE MORTALITY RATE OF PATIENTS SUBJECTED TO RESECTION OF THE LARGE INTESTINE IN THE TWO PERIODS

Type of Operation	Operative Mortality Rate (Per cent)	
	1935–1940	1940–1945
Resection and anastomosis....	23.3	15.9
Mikulicz.....	20.0	26.6
Combined abdominoperineal..	32.1	18.4
Total average.....	25.9	18.0

figures in this table show the total reduction in the mortality rate from 25.9 to 18 per cent. This is more significant when it is realized that most of the fifteen patients who underwent Mikulicz resections in the period from 1940 to 1945 were poor risks.

TABLE V
PALLIATIVE OPERATIONS EXCLUDING COMPLEMENTARY COLOSTOMY IN THE TWO PERIODS

Type of Operation	1935–1940	1940–1945	Total
Enteroenterostomy.....	11	15	26
Colostomy.....	50	30	80
Cecostomy.....	0	7	7
Ileostomy.....	0	1	1
Exploratory laparotomy.....	18	16	34
Total.....	79	69	148

The average number of postoperative hospital days was twenty-six in resections and anastomoses, thirty in Mikulicz resections and thirty-seven in combined abdominoperineal procedures. Most of the patients who underwent Mikulicz resections were discharged with an open colostomy and readmitted subsequently for closure.

Palliative Procedures. Under this heading are included all exploratory laparotomies, en-

teroenterostomies and decompression procedures that were performed instead of resections. Cecostomy or colostomy performed prior to or simultaneously with a resection is not considered a palliative procedure. One hundred forty-eight palliative procedures were performed; the various types are shown in Table v. The operative mortality rate was 21.6 per cent.

Two-stage Procedures. The relatively small number of two-stage operations does not allow a fair comparison with the large number of one-stage procedures in this series.

SUMMARY

1. Five hundred two cases of patients seen at University Hospitals of Cleveland during a ten-year period with carcinoma of the colon or rectum are reviewed.

2. The average age of the patients was 58.2 years; males and females were equally divided.

3. The average duration of symptoms prior to admission to the hospital was 9.5 months. The principal cause of the delay in diagnosis was failure of the patients to seek medical advice.

4. Sixty-seven per cent of all carcinomas of the large intestine occurred in the sigmoid or rectum.

5. Regional lymph node metastases were found in 30.4 per cent of the resected specimens.

6. The operability rate was 79.9 per cent. The resectability rate was 50.4 per cent. The operative resectability rate was 63.1 per cent.

7. The over-all mortality rate was 22.5 per cent. The operative mortality rate was 21.9 per cent and the resection mortality rate 22.2 per cent. The resection mortality rate from 1935 to 1940 was 25.9 per cent whereas from 1940 to 1945 it was 18 per cent.

8. The trend away from exteriorization procedures and toward resection and anastomosis is evident.

9. Most of the resections of the colon done on the staff service were performed by the surgical residents.

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BILATERAL RENAL CALCULI*

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THE management of bilateral renal calculi is always a perplexing problem. In searching for a better method of handling this problem twelve case histories were studied at the White Memorial Hospital and are reported at this time.

The majority of the patients were in the third, fourth or fifth decade of life, the lesion rarely occurring in the second or sixth decade.

As would be expected, pain in the back brought 85 per cent of our patients to the hospital. The other patients sought relief from hematuria, dysuria, cloudy urine or chills and fever. Ten of the twelve patients had had attacks of back pain off and on for five to fourteen years before admission. One patient had had intermittent hematuria with clots for fifteen years. Three gave a history of previously passing kidney stones. Patients complaining of back pain were usually found to have tenderness at the costovertebral angle or anteriorly over the kidney area or both. Two patients were found to have a mass in the loin without tenderness.

Three patients had bilateral staghorn calculi; three patients had staghorn calculi on one side and stones in the kidney pelvis on the other. Of the other six patients, four had stones in the kidney over 1 cm. in diameter and two had stones less than 1 cm. in diameter. In addition two had obstructing ureteral calculi.

In three of the twelve patients both kidneys showed good function. In one patient function was good on one side and fair on the other; in another it was good on one side and not good on the other; in still another patient it was fair on one side and not good on the other; lastly, one patient had no measurable function on either side. This latter patient had an obstructing ureteral calculus on one side and an extensive calculus pyonephrosis on the other.

The urine from most of the patients showed gram-negative bacilli, pus and red blood cells; a lesser number showed gram-positive cocci. As a rule there was moderate elevation of the non-protein nitrogen ranging from 42 to 69 mg. per cent. One patient had 131 mg. before operation; this fell to 68 mg. one week following surgery. There was seldom an elevation of over 11,000 or 12,000 in the white cell count, and a decrease in the red count and hemoglobin was the exception. Two patients showed hemoglobin of 60 per cent and 78 per cent, respectively.

FIG. 1. Patient aged fifty-five; bilateral renal calculi. Pain in left kidney was relieved by chemotherapy only; symptom-free from 1944 to date.

Eight of the twelve patients were operated upon in most instances for the relief of pain. A fewer number had surgery for obstruction, infection, hematuria or increasing hypertension. Of the four patients not operated upon, three were made symptom-free by chemotherapy. (Fig. 1.) They are being watched in our return clinic. The other patient was relieved of her

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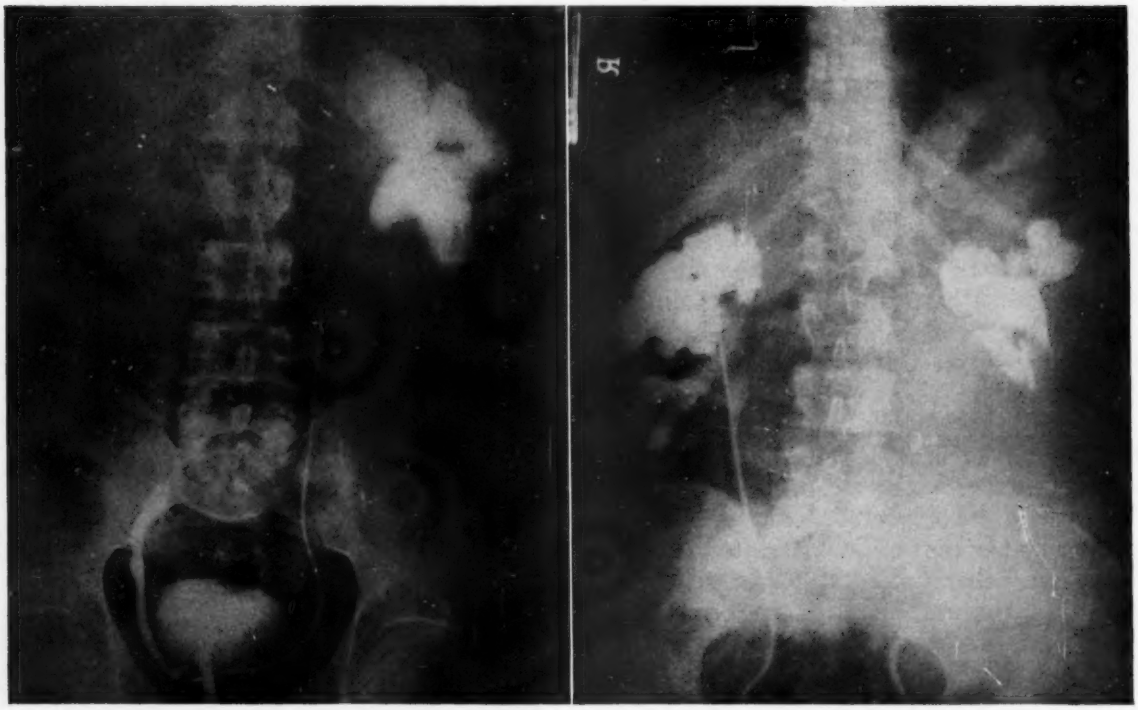

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FIG. 2. Calculus 1.5 × 2.5 cm. in lower right ureter; staghorn calculus on left (no dye has been injected on this side).

FIG. 3. Same patient as in Figure 2 three years after surgery showing bilateral hydronephrosis; patient was in good health until four years postoperatively when he died at the age of sixty of coronary thrombosis.

right renal colic after cystoscopy. Five months later she returned to the hospital with pain in the right side and a ruptured appendix was removed.

Two patients had a ureterotomy for large obstructing calculi. In one the silent calculus was removed first because the better kidney was on this side.[1] In the other patient the ureteral calculus was removed first because of pain on this side.

Our surgical procedures consisted of five pyelolithotomies, five pyelonephrolithotomies, one pole-to-pole splitting of the kidney for staghorn calculus pyonephrosis and two ureterolithotomies; a nephropexy was performed upon one kidney after pyelolithotomy. One of the previously mentioned patients in an eight-year period underwent three pyelolithotomies on the right side and two pyelolithotomies on on the left.

There were no serious postoperative complications. Chemotherapy was routinely given before and after surgery, for example, sulfacetimide for the bacillary infections and penicillin for the coccus infections. Early ambulation was practiced when it was feasible, the patient getting out of bed on the eighth or tenth postoperative day. One patient went home on the sixth postoperative day. When a pyelostomy tube was used, it was removed about ten days postoperatively.

In a pole-to-pole splitting of the kidney for staghorn calculus pyonephrosis, one hemostatic bag catheter was placed in the upper pole and another in the lower pole. Penicillin solution was used for irrigation. The catheters were removed on the twelfth day and there was no leakage. One patient was moderately distended for the first twenty-four hours. This was relieved during the next two days. Secondary bleeding on the twelfth postoperative day in one patient was controlled by three blood transfusions. Two patients had a ureteral catheter inserted on the twelfth postoperative day to aid the healing of the wound in the kidney pelvis following removal of the pyelostomy tube. In one case eight months after removal of a staghorn calculus a perinephritic abscess developed. After drainage the patient made an uneventful recovery.

As closely as we could follow-up our patients, all are alive and well or convalescing since dis-

charge from the hospital, with one exception. He died four years after surgery of coronary thrombosis at the age of sixty. (Figs. 2 and 3.) One patient forty-three years of age had not returned to work three months after removal of staghorn stones from both kidneys. His recovery has been slow and we fear he has a poor outlook. One patient with a large staghorn calculus pyonephrosis had a recurrence of stones. They were 1 cm. in diameter and produced no symptoms; they were left alone.

SUMMARY

1. Eighty-five per cent of our patients with bilateral renal calculi sought relief from loin pain.

2. Two-thirds of our patients were relieved with surgery and one-third with conservative treatment. At times silent staghorn calculi with minimal infection are better left alone and the patient kept under observation.

3. To enhance the total renal function of the patient, it is wise to remove obstructing calculi first.

4. We again stress the point that each patient is a problem in himself. The physician must carefully study the cystoscopic, x-ray, functional and laboratory findings. These facts are weighed against the patient's age, physical condition and symptoms, before deciding on the course of treatment which will best serve the patient.

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External hemorrhoids are varicosed and dilated branches of inferior hemorrhoidal veins, and empty into the caval system. Internal hemorrhoids (branches of the superior hemorrhoidal veins) empty into the portal system. Both types of hemorrhoids may coexist with cancer of the rectum but especially the internal ones. In some clinics as high as 20 per cent of all cases of rectal cancer have undergone a previous hemorrhoid operation. Some of these clinics, therefore, have recently adopted the procedure of supplementing a rectal and sigmoidoscopic examination by a barium enema in all patients over forty years of age with hemorrhoids. However, so far these added labors have been of little avail since no appreciable number of cancer cases were discovered thereby. Probably, therefore, such routine roentgenographic examination may be considered unjustified. (*Richard A. Leonardo, M.D.*)

TRAUMATIC ANEURYSM OF THE RADIAL ARTERY*

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A TRAUMATIC aneurysm is a false aneurysm and is one in which the sac is formed by the surrounding tissues. It is caused by a tear or a cut of a vessel and is a hematoma which connects with the main arterial channel. It is not frequent that a physician is confronted with an aneurysm of the radial artery and much less frequent one with a history dating over a period of twenty-three years since the original trauma. Much has been written about aneurysms and arteriovenous fistulas, their diagnostic points and the difficulties encountered in treating them which are created by the locale of the aneurysm or fistula and the questionable presence of a sufficient collateral circulation. In aneurysms of the radial artery such hazards are not present.

The natural reparative processes occurring in any traumatized area are also observed in wounds of blood vessels with the exception that the factors of a intra-arterial pressure and clotting modify the end result of the healing. Should the arterial wall heal, the scar formed is a locus minoris resistentiae. The arterial pressure modifies the scar, thins it, stretches it and balloons it outwardly with the formation of an aneurysm. The danger of rupture is ever present, but this danger is modified by the nature of the surrounding structures as well as by the adhesive reaction set up in them through pressure of the aneurysm. Where the hematoma forms the aneurysm, the same factors determine its course. As long as the surrounding structures are elastic and there is a good fibroblastic response present about the immediate vicinity of the aneurysm, it will not rupture, but it will increase in size. Any future trauma to the same area, however, will rupture the sac to varying degrees. The elasticity of the surrounding tissues will serve to contain the extravasated blood and the clot thus formed will eventually become walled off, organized and will form an offshoot of the original aneurysmal sac, or be a part of it. It is thus that it becomes possible for an aneurysm of an extremity to assume immense proportions over a period of years and to show various stages in the reparative process. The oldest clot of the aneurysmal contents will show organization and calcium deposition and the various laminations will show degrees in the stages of this process. (Fig. 1.)

The clinical signs of an aneurysm of the extremities will be modified by the duration of the aneurysm and the degree of intra-aneurysmal pathologic alteration. Early in its existence one may expect to get an expansile impulse, hear a bruit or be able to compress the aneurysm. In the later stages, when extensive organization and calcification have taken place, these are or may be entirely absent. The only signs or symptoms at this stage are those caused by pressure on the surrounding structures. This makes the diagnosis of aneurysm difficult and an erroneous diagnosis of a neoplasm possible. A quotation by Matas that "There is probably no other disease which exhibits such a long list of diagnostic errors" deserves recapitulation.

Of the aneurysms occurring in the superior extremity, those of the radial artery are least dangerous to the viability of the limb. Their surgical removal is accomplished with comparative ease. The limb is not deprived of its blood supply because it is endowed with a rich collateral circulation, especially that between the radial and ulnar arteries through the deep volar arches of the palm and the additional channels about the elbow. An aneurysm of the radial artery, therefore, can be removed *in toto* after ligation of the proximal and distal ends of the artery.

A case illustrative of these facts was referred to one of us (H. L. G.) for diagnosis and surgical removal of the tumor. A previous diagnosis of an osteogenic sarcoma had been made on this woman and amputation of the limb advised. However, the patient returned to the referring physician who had seen her following the original trauma, a severe contusion caused by

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FIG. 1. Degrees of calcification in various laminations of removed clot.

falling on her right arm while carrying a heavy package twenty-three years previously. At that time he had made the diagnosis of a traumatic aneurysm of the radial artery because of the expansile nature of the tumor, its compressibility and the presence of an audible bruit. He advised surgical removal at that time which the patient refused. Through the passing years she had on four separate occasions sustained additional trauma to the same area followed by sudden increase in the size of the tumor but unattended by much pain. Because the tumor attained cumbersome dimensions which prevented the patient from flexing her forearm or wearing standard clothing, she condescended to have it removed at this time.

The patient, A. O., a seventy-six year old white female, entered Mary's Help Hospital on September 24, 1944, for study and possible surgical removal of a tumor on her right forearm just below the bend of her elbow. She was an emaciated, asthenic individual, not acutely ill. Her skin was atrophic and in folds, and marked senile keratosis was evident. Her chest was bilaterally symmetrical; the thoracic cage prominent and rigid. The mammae were atrophic and free of masses. The superficial veins of the chest were markedly dilated, tortuous and those above the left breast

FIG. 2. Tumor mass of right forearm, lateral aspect; enlargement and tortuosity of superficial vessels seen.

palpably sclerotic. The lungs were hyperresonant throughout, emphysematous, but no rales were audible. The heart tones were distant and poorly heard. Her blood pressure varied in both arms; it was 166/40 in the left and 110/38 in the right. In the latter extremity the bell of the stethescope was placed below the tumor in the course of the radial artery. The pulse rate was 68 per minute and of fuller volume in the left radial artery. Both radial arteries showed a Mönckeberg type of sclerosis. On the anterior surface of the right forearm just below the bend of the elbow there was a large tumor, 16 cm. in diameter and 12 cm. in elevation. It was bony hard in many areas and fluctuant or cystic in others. The tumor was not compressible or freely movable, and pulsation was lacking. A bruit could not be heard on auscultation. The superficial veins traversing the tumor were tortuous and markedly dilated. (Fig. 2.) Numerous collateral veins were obvious. Despite the atrophy of the musculature distal to the tumor, the patient was able to pronate and supinate her forearm with ease and she had no loss of function of her hand. Both hands showed a degenerative arthritis deformans of a moderate degree. Other physical findings were noncontributory to the establishment of a diagnosis of traumatic aneurysm of the radial artery. The patient's serologic reaction was negative and a routine blood count showed a secondary normocytic hypochromic anemia.

Despite the history and physical findings which were strongly suggestive of an aneurysm, we decided to confirm this diagnosis. Anteroposterior and lateral roentgenograms were taken to detect any connections between the mass and the bones of the forearm. (Figs. 3 and 4.) These failed to demonstrate any contiguity of it with either the radius or ulna, whose cortical contour was undisturbed. An attempt was made to inject an opaque solution into one of the vessels seen traversing the

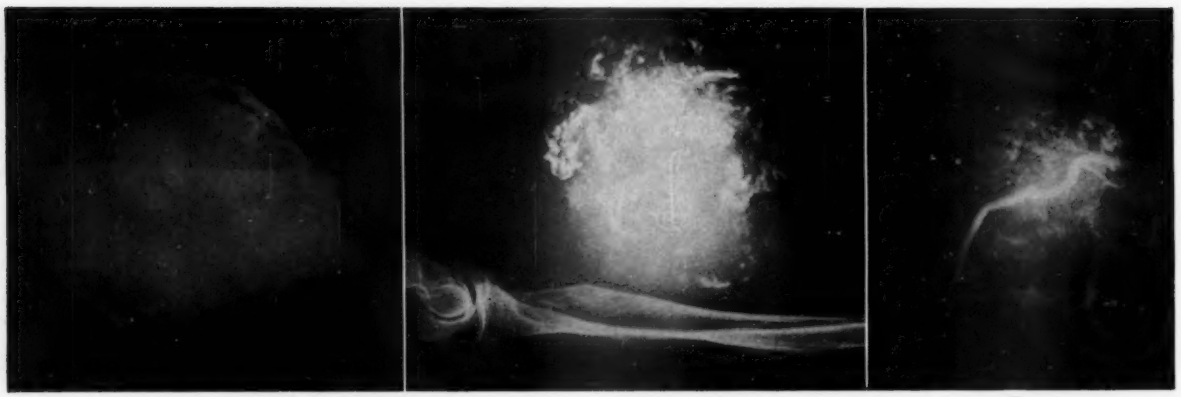

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FIG. 3. Anteroposterior roentgenogram of right forearm demonstrating clearness of outline of radius and ulna and their independence of the mass.
FIG. 4. Lateral view showing clear cortical outlines of radius and ulna and extensive calcification of tumor.
FIG. 5. Outlines of superficial veins traversing the tumor mass.

aneurysm, but this only revealed the outlines of the superficial veins. (Fig. 5.) The tumor was then aspirated because of its cystic character and smears of the fluid showed many red blood cells and a few polymorphonuclear leukocytes.

On October 4, 1944, the patient was operated upon under local infiltration anesthesia. An oval incision was made over the entire aneurysm extending well beyond its boundaries. The deep fascia was incised in the long axis of the aneurysm. The supplying vessel was identified as the radial artery lying under the atrophied brachioradialis muscle and medial to its lateral border. The radial nerve was not exposed because it lies well lateral to the normal course of the artery in the upper third of its antebrachial portion. Since the radial artery, like the ulnar, may be ligated any place in its course without endangering the viability of the extremity, it was doubly ligated about 1.5 cm. above its entrance and exit from the aneurysm. All collateral branches were exposed and doubly ligated. Because of the marked fibrosis about the aneurysmal mass some portions of muscle were sacrificed.

On section, after removal, the mass was seen to be composed of old, grayish brown clots on the periphery which were studded with a multitude of calciferous deposits. The various laminations concentrically placed showed varied colored clots from 2 to 15 cm. across and of different consistency, the most recent being gelatinous and dark red in color. An oval section of skin was attached to one portion of the clot. Beneath the skin were numerous small, calcified zones. Microscopically, the corpuscular outlines in the old clots were indistinct. One section showed a portion of the aneurysm whose intima was covered by considerable thrombus. There was much irregular amorphous calcification of the media associated with marked fibrosis. Numerous lymphocytes and polymorphonuclear leukocytes focally infiltrated the adventitia and to a lesser degree the media. Adjacent sketetal muscle fibers showed a marked degree of fibrosis.

The patient made a relatively uneventful recovery. She was discharged on October 25th, three weeks following surgery, at which time she was able to pronate, supinate and flex her forearm without any inhibitions. The function of her hand was not impaired.

COMMENT

The literature referable to aneurysms of the radial artery is very meager. This is partly because of the relative ease encountered in diagnosing the condition and in eliminating it. Galen identified arterial aneurysms during the second century A.D. Acute traumatic aneurysms were described as "pulsating hematomas" by Aetius and Paulus in the sixth century. William Hunter recognized and described an arteriovenous aneurysm at the bend of the elbow twelve centuries later, and his brother John proved that the conservation of the collateral circulation was most important in the treatment of blood vessel lesions. In this early period the pathologists, Frederik Ruysch (1683 to 1731), Giovanni Battista Morgagni (1682 to 1771) and Joseph Hodgson (1788 to 1869), especially the latter, wrote extensively on the

pathogenesis of aneurysms. In 1931 Campbell,[1] in a series of fifty-five cases of aneurysm in peripheral and surgically accessible vessels accumulated over a period of years, reports an aneurysm of the radial artery resulting from a contusion. More recently Elkin[2] described a young soldier having an aneurysm of the radial artery of nine months' duration and the method used in its extirpation. Kimbarovski[5] in a review of traumatic aneurysms which he encountered from 1941 to 1946 discusses their treatment and the relative ease encountered in management of those in the superficial vessels. Others[3,4] described various aneurysms of the extremities due to trauma which they encountered. None, however, are mentioned affecting the radial artery, which is perhaps an indication of their relative rarity. However, patients may be seen which do not present easily identifiable clinical manifestations and the intra-aneurysmal pathologic changes may be so extensive as to baffle the investigator. Standard texts of pathology do not include any extensive commentary concerning the eventual outcome of such aneurysms and a case which is traceable for twenty-three years without a serious mishap is interesting and worth reporting. That its clinical diagnosis may be confused with that of an osteogenic sarcoma is readily understandable in the light of the pathologic alterations caused by attempts at healing. The process, it seems, set up barrier upon barrier to prevent disruption and to contain the blood stream in its predestined channel. It is successful to a marked degree provided that in its expansionary program it does not encroach on other vital structures.

SUMMARY

A case of an aneurysm of the radial artery traceable over a period of twenty-three years is presented, and the literature on this type of lesion is reviewed. Its pathologic condition is discussed and alluded to is its similarity in impression to an osteogenic sarcoma. The fact that an aneurysm may grow to such extensive proportions and over such a long period of time without a serious mishap warrants presentation.

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SURGICAL TREATMENT OF VARICOCELE

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ONE of the anatomic weaknesses of the human organism is the emptying of the left internal spermatic vein into the left renal vein at right angles. When the valves of the internal spermatic vein are incompetent, venous stasis in the pampiniform plexus results causing the scrotal veins to enlarge and the testicle to become more dependent. The condition is rare on the right side because the right internal spermatic vein empties obliquely into the inferior vena cava and rarely is incompetent. The incidence of this defect is high in the young male population although most cases are without disabling symptoms. However, when discomfort and pain are present, the condition often requires surgery for alleviation.

Varicocelectomy has long been an unsatisfactory surgical procedure, carrying with it numerous pitfalls. The classic procedure of dissection and excision of the distended veins in the scrotum is technically a difficult undertaking, often failing to relieve symptoms and frequently resulting in undesirable complications such as hemorrhage, atrophy of the testicle and hydrocele formation. Accordingly, many urologists and surgeons have been reluctant to advise operation in cases of symptomatic varicocele.

Ivanissevich over twenty years ago described accurately the venous drainage system of the testicle and recommended high ligation of the internal spermatic vein as treatment of painful varicoceles.[1] Bernardi[2] later described a new technic utilizing an inguinal incision and dissecting out all veins within the inguinal canal. It remained, however, for Javert and Clark[3] to describe a modification which simplifies Bernardi's operation and promises to replace all other surgical procedures for the correction of varicocele. Their operation is known as ligation of the internal spermatic vein.

Anatomy. The pampiniform plexus of testicular veins is drained by deep and superficial venous systems. The deep system is made up of the internal spermatic vein, the vein of the ductus deferens (a tributary of the hypogastric vein) which anastomoses with the internal spermatic vein within the epididymis and testicle, and the external spermatic veins (leading to the inferior epigastric vein) which anastomose with the internal spermatic in the cord. The superficial system is composed of the superficial and deep epigastric veins, the superficial internal circumflex vein, and the scrotal tributaries of the superficial and deep external pudendals (all leading to the femoral vein) and the internal pudendal vein. All of these anastomose with each other and the external spermatic vein near the external inguinal ring within the cord.[3,4]

Understanding the circulation of the testicle and surrounding regions, the logical operation is to relieve the back pressure caused by the anatomic weakness of the internal spermatic vein by ligation of this vessel above the points of anastomosis of the various components of the venous system in the pampiniform plexus.

Operation. An incision is made as for a herniorrhaphy except that the length rarely needs to be more than 6 cm. unless a concurrent hernia is present. If an unsuspected hernia is encountered, extension of the incision will be necessary. The aponeurosis of the external oblique muscle is incised down to or through the external inguinal ring, being carried laterally to expose the abdominal inguinal ring. The cremasteric muscle and fascia are incised longitudinally at the proximal end of the inguinal canal, and the internal spermatic vein is dissected free for a distance of about 5 cm. The vein is securely ligated at the internal ring and at the distal portion of the dissection. The vein is excised between the ligatures, the proximal end being allowed to retract into the abdominal cavity. In some instances the internal spermatic vein is formed inside the abdominal inguinal ring and there are two large branches instead of a single vein in the cord at the lateral end of the inguinal canal. Both veins are ligated in such cases. This occurred three times in the ten patients reported in this series. The longitudinal incision in the cremasteric muscle and fascia is closed

transversely with a running suture. The distal end of the ligated internal spermatic vein may be included in this closing stitch. Closure of the cord in this manner causes elevation of the dependent left testicle.

Careful search of the cord for possible indirect herniation should be done in all cases.

TABLE I
INCIDENCE OF HERNIA IN CASES OF VARICOCELE

Series	Patients Operated upon	Hernia Suspected	Hernia Found (Per cent)
Javert-Clark	32	32	32
Riba	23	?	3
Price	10	3	2

Small hernias were found in two of the author's ten cases. (Table I.) In such instances high ligation of the sac and repair of the posterior wall of the inguinal canal are necessary. Further closure of the wound should be done in layers.

Postoperatively the patient should wear a scrotal support for about one week. He is allowed bathroom privileges on the first postoperative day and gradual ambulation thereafter. Hospitalization is usually unnecessary after three or four days in cases in which herniorrhaphy is not done.

Results. This series consisted of ten cases of symptomatic varicocele, in which all of the patients complained of a feeling of heaviness in the scrotum and a dull ache in the left groin made worse by increased physical exertion and most distressing in the afternoon and evening hours. In addition a few of the patients complained of occasional sharp pains in the groin of varying intensity and usually of short duration. All of these patients were given extensive trial with scrotal suspensories without relief before surgery was recommended.

In nine of the ten patients the varicocele was dramatically reduced in size within seventy-two hours and in most of these cases it was imperceptible to inspection within ten days. (Table II.) The tenth patient had previously undergone a left inguinal hernioplasty and the cord was scarred to such an extent that the veins could not be accurately indentified and dissected. This patient was not relieved of either the varicocele or his symptoms of discomfort.

Eight of the ten patients were relieved of their symptoms before discharge from the hospital on the tenth or eleventh postoperative day. Of the two not relieved, one was the patient previously mentioned who had the scarred cord and had undergone unsuccessful dissection. The other patient (cured of his varicocele) still complained of dull aching in the testicle and groin although to a slighter degree than before surgery. He was last seen three weeks postoperatively.

TABLE II
RESULTS OF LIGATION OF THE INTERNAL SPERMATIC VEIN

Series	Patients Operated upon	Varicocele Cured (Per cent)	Symptoms Relieved (Per cent)	
			Total	Partial
Javert-Clark	22	100	100	
Riba	23	100 (smaller)	87	?
Price	10	90	80	10

The results of this series compare favorably with the series of twenty-two cases reported by Javert and Clark and the twenty-three cases reported by Riba. (Table II.) No complications were encountered.

CONCLUSIONS

The high incidence of postoperative complications previously seen following varicocelectomy have been largely eliminated and operative success greatly enhanced in treating symptomatic varicoceles with ligation of the internal spermatic vein and simultaneous herniorrhaphy in cases in which this defect is also present.

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SCIATIC SCOLIOSIS

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SCIATIC scoliosis is a term which has been in use for many decades. It may be defined as a condition in which there is a lateral and forward tilt of the trunk secondary to a painful lesion in the lower back, the buttocks or a sciatica. Actually it is a misnomer since there often is no sciatic pain or is there a real scoliosis. Nevertheless the term is a good one since it connotes a definite clinical entity.

Clinical Syndrome. The patient is usually between twenty and fifty years of age and, aside from the deformity and backache, is seemingly in good health, often very muscular and vigorous. I have seen this condition only once or twice in the teen age group and do not recall having encountered it in an old person. The chief complaint is pain in or in the vicinity of the lower back. The appearance of the patient is quite characteristic. (Figs. 1 and 2.) He sits, stands and walks with his trunk shifted laterally and forward. The degree of the lateral tilt varies from a few to 40 or even 50 degrees. The flexion of the trunk varies also from 5 to as much as 90 degrees. The back is unusually flat, with a reduction in the posterior curvature of the dorsal area and more particularly a loss of lumbar hollow. The lumbar lordosis may even be replaced by a kyphosis. The spine is correspondingly tilted, the dorsal segment in the direction of the tilt of the trunk and the lumbar vertebrae to the opposite side. No matter how severe the lateral distortion of the spine there is very little rotation of the vertebrae. In this regard sciatic scoliosis differs decidedly and distinctively from structural or habitual scoliosis. One never sees the extreme degrees of lateral and forward tilting of the spine and trunk in rotary lateral curvature of the spine which one commonly encounters in sciatic scoliosis. The paravertebral lumbar muscles in sciatic scoliosis are in marked spasm. The motions in the lumbar area are restricted and forced motion in the spine or the extremities exaggerates the pain. Palpation elicits tenderness in the back, buttocks or along the sciatic nerve, and is most marked at the site of the primary lesion.

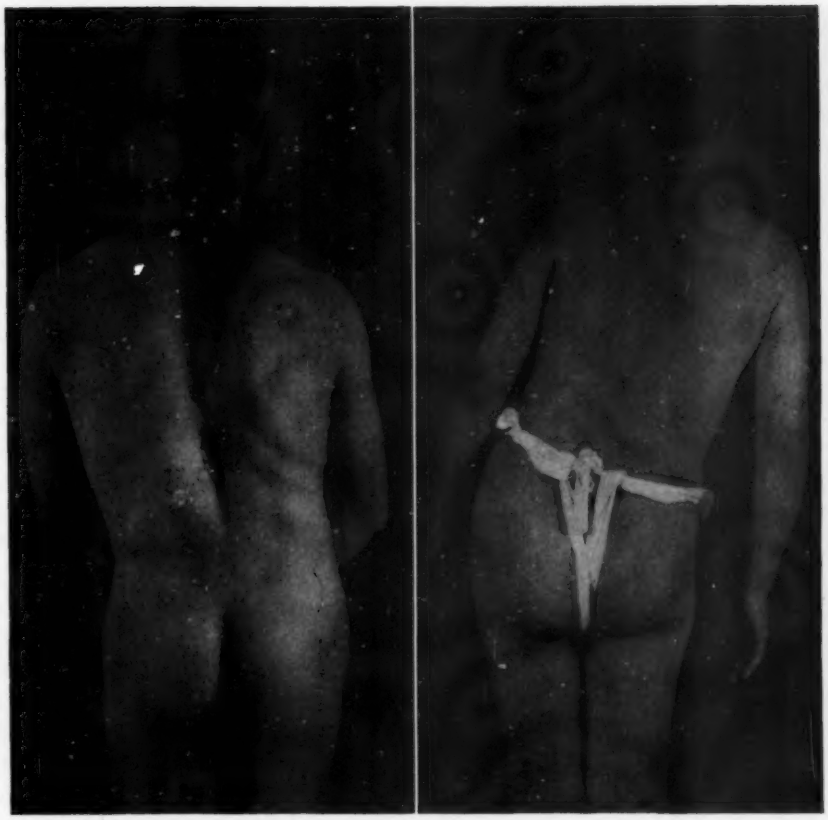
The roentgenograms are important in revealing osseous pathologic disorders. They show the lateral deviation of the spine which, of course, disappears when the distortion of the trunk is corrected. When a patient has a lytic or a hyperplastic lesion in the vertebrae and a secondary and incidental tilt of the spine, the condition does not belong in the category of sciatic scoliosis but in that of the structural osseous condition.

ETIOLOGY

The pathologic processes causing sciatic scoliosis may be located in the back, buttocks or the sciatic nerve and involve the following tissues: the fascia, muscles and ligaments of the lumbar area, pelvis and buttocks; lumbar apophyseal joints; sacroiliac joint; intervertebral discs; pelvic organs; retroperitoneal tissues and sciatic nerve.

Fascia. The lesions in the fascia are the result of either trauma or inflammation. Albee's myofascitis comes under this category. Some fibers of the fascia are torn usually following a direct blow or more often a sudden unexpected strain or twist. The healing process, ordinarily brief, is often prolonged by reason of the fact that the injury is mild and the patient continues at his accustomed occupation which precludes the necessary local rest requisite for prompt repair and recovery. A trauma to or inflammation of the fascia is diagnosed on the basis of the history, localized pain and localized superficial tenderness.

Muscles. Any of the muscles of the lumbar area or the buttocks may be the site of a localized injury and/or an inflammation. Some twenty years ago Percy Roberts and more recently Clarence Heyman emphasized the susceptibility of the gluteal muscles, especially the medius and maximus, to inflammation, particularly in the vicinity of their origin from the ilium and sacrum, and advised stripping of these muscles from their bony attachments for enforced relaxation. Dr. Albert Freiberg believed that the pyriformis muscle was often the seat of



1 2

FIG. 1. Left sciatic scoliosis secondary to lumbosacral sprain; note the deviation of the trunk and spine, flattening of the dorsal segment and an absence of any considerable degree of rotation of the vertebrae and ribs.
FIG. 2. Right sciatic scoliosis secondary to a left sciatica due to a respiratory infection; note the very marked lateral shift of the trunk and spine but very little rotation of the vertebrae and ribs such as would inevitably be present in this degree of deviation of the spine in an habitual or structural scoliosis.

spasm or inflammation with resultant irritation of the sciatic nerve. The diagnosis of myositis is based on localized pain and tenderness accompanied at times with palpable muscle thickening and is presumptive rather than definitive, although Roberts, Heyman and the author did find, each on one occasion, muscle inflammation confirmed by histologic examination.

Ligaments. The ligaments of the vertebrae and the pelvis are numerous and, like similar structures elsewhere in the body, they are subject to injury. A strain or tear of a deep-seated ligament does not cause immediate and total disability, although exceptionally that does happen, but does cause variable pain and partial and recurring disability which may last for months and even years. The diagnosis cannot be made with accuracy because the physical signs are deep-seated and not apparent. A strain of the external ligament of the ankle is readily diagnosed because of the evident swelling and ecchymosis. A strain of a lumbar apophyseal joint ligament is equally plausible although the associated swelling and hemorrhage are not apparent. For the diagnosis of lesions of the ligaments of the spine and pelvis the following are essential: honesty of the patient, a history of an injury, localized pain and localized tenderness to deep pressure.

Apophyseal Joints. The lumbar apophyseal joints are similar in their anatomic structure to other joints, respond to injury, toxic influences and infections like other joints, and hence may be and are the sites of pathologic processes commonly seen in other joints. Because of the more or less constant motion in the spine they are particularly susceptible to the degenerative effects of use—the so-called wear and tear of life. Accordingly we may find in the apophyseal joints synovitis, arthritis, marginal spurs, chon-

FIG. 3. Multiple lumbosacral lesions; these were very evident in the original film; (*a*) ununited fracture of ascending articular process of sacrum; (*b*) ununited linear fracture through base of descending articular process of L_5; (*c*) upward displacement of sacral articular process.

dromalacia and intra-articular fractures (Fig. 3.) The presence of a disorder may be assumed if the requirements for ligamentous lesions, outlined previously, are present and the roentgenograms give evidence of articular disturbances. Chondromalacia may frequently be suspected but can only be proven at operation.

Sacroiliac Joint. Much controversy has existed over the possible lesions in this joint. Some have believed that there is virtually no motion in this joint and that the simpler disturbances such as a sprain are non-existent. Others, including this author, believe that the sacroiliac joint has not only all of the attributes, structure and weaknesses of other joints but also, being rather extensive in area and located between the very mobile trunk and the active lower limbs and receiving the weight and strain of activity of the trunk, is peculiarly and inordinately sensitive to traumatic disturbances, infections and toxic processes. Take the instance of the following case: A dancer during rather active and violent motion jumped up and in descending did the "split." He had immediate intense pain in the right sacroiliac area and was almost completely disabled. He was carried off the floor and later barely managed to stand and walk. When seen several days later he had a list of his trunk and marked pain and tenderness limited to the right sacroiliac area. An x-ray film showed unequivocal haziness of the right sacroiliac joint. The diagnosis of a sprain with probable hemorrhage into the right sacroiliac joint can hardly be questioned. Lesser degrees of sprain are frequently sustained through minor injuries; yet they are none the less real and may produce temporary or prolonged disability. They may totally incapacitate the individual for laborious work, prolonged standing or heavy lifting. Severe lesions like tuberculosis and intra-articular fractures are readily admitted by all but the milder lesions, particularly those unaccompanied with roentgen evidence of bone and joint disorders cause much controversy. However, every pain in the lower back should not be diagnosed as a sacroiliac derangement. As in lesions in the muscles, ligaments and the apophyseal joints there should be undoubted proof of pain in and sensitivity of the sacroiliac joint, under which circumstances a positive diagnosis of a sacroiliac disturbance can be made, with or without confirmatory roentgenographic changes.

Intervertebral Discs. Subsequent to the recognition by neurologic surgeons of the lesion of a herniated intervertebral disc and its clinical implications, and more particularly the possibility of the surgical removal of the displaced cartilage, a wave of enthusiasm developed with the strong tendency to attribute every backache, especially one accompanied with sciatic pains, to a herniated disc. It requires but little imagination to appreciate that a backache with or without sciatic pain may be due to any one of very many causes. A diagnosis of the exact etiology should be made and the treatment planned accordingly. There can be no doubt of the potential existence of herniated discs and that some of them require surgery. (Fig. 4.) I cannot get away from the feeling that many patients can be relieved, as they have many times in the past, with conservative treatment. Therefore, when the diagnosis of a herniated disc has been established, a period of conservative therapy should be instituted because of the following reasons: (1) many patients recover without operation; (2) only about 65 per cent of those operated upon are cured; (3) recurrences after removal of a part of the disc have been reported; (4) the operative area being small damage to the lumbar nerve roots is possible and (5) as in all operations there is an operative risk.

Contrariwise, operative intervention is unequivocally indicated in cases in which the symptoms are intense, recurrent symptoms are present or conservative treatment has failed.

The diagnosis of a herniated disc should be made on the basis of symptoms and signs pointing to pressure by a herniated segment of the disc upon one or more of the lumbar nerve roots with confirmation whenever possible via spinal puncture and myelography. (Fig. 4.)

In an acute case and in the primary attack I readily agree that removal of the offending segment of intervertebral cartilage may be entirely adequate. However, in instances of recurrent attacks it is better to combine fusion of the spine with the neurosurgical procedure for the following reasons: (1) Immobility of the spine at the site of the herniation is desirable to preclude future herniations. (2) In recurrent and severe cases there is an inevitable disturbance of the apophyseal joints through the lateral tilt of the trunk and the muscle spasm. (3) Surgical removal of part or all of a disc leaves a space between the vertebral bodies which creates a measure of instability not only between the bodies of the vertebrae but also in the corresponding intervertebral articulations. (4) In the hands of well trained surgical teams the additional time and trauma of fusion of the spine is of little consequence when compared with the ultimate benefit derived.

Pelvic Disturbances. Pelvic derangements are common but only infrequently cause backache of a degree sufficient to give rise to a lateral tilt of the trunk and disability. I recently had under my care a young multipara who had a severe sciatic scoliosis due to a very marked retroversion of the uterus. It has been estimated that backache is present in about 15 per cent of pelvic disturbances. In my own experience very few women suffering from chronic and recurrent backache have had definitely related intrapelvic pathologic disorders. Yet there can be no question of the advisability of a competent pelvic examination in women who have backache. Pathologic conditions when found should be remedied. A consultation between gynecologist and orthopedic surgeon should be a *sine qua non* as it may prevent unnecessary pelvic surgery, for we have all seen women who have had ventrofixation, partial and even total hysterectomies for the relief of backache due to lumbar arthritis, sacroiliac arthritis or other disorders within the tissues of the back.

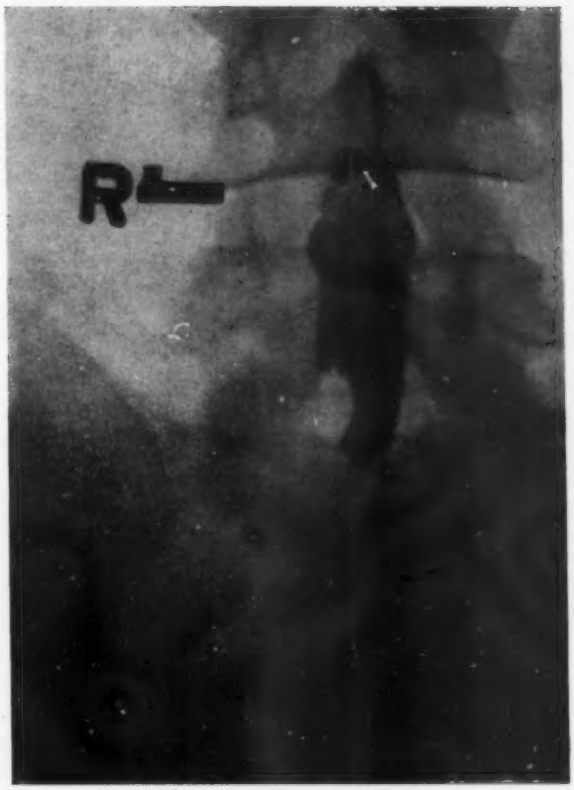


FIG. 4. Pantopaque myelogram; herniated disc between L_5 and sacrum on right side. Patient was a young man; pathologic disorder found at operation and removed.

Retroperitoneal Tissues. Retroperitoneal pathologic conditions such as perirenal abscess and tumors may cause backache and give rise to an attempted relief of pain by a lateral tilt of the trunk. We must depend on a thorough physical examination to disclose the essential lesion.

Sciatica. Sciatic neuralgia, disturbing the patient through more or less disabling pain along the sciatic nerve, is a common condition. It may be accompanied with tingling and numbness and even some atrophy of the thigh. There is, however, never any decided disturbance of the reflexes or sensation, no loss of muscle power or muscle twitchings and no circulatory or trophic changes. The condition is, therefore, not a real neuritis but of the nature of an irritation of the sciatic nerve conveniently termed a neuralgia. The etiology is obscure but is probably of traumatic or toxic origin. (Fig. 2.) It is self-limited although its duration varies from several weeks to several months. In its more severe forms it evokes instinctive attempts to relieve the pain by tilting of the trunk away from or toward the side of the lesion, giving rise to a sciatic scoliosis.

In a review of some private cases of sciatic scoliosis the ages of the patients varied from ten to fifty-four, with the average age of thirty-seven years. There were considerably more males than females. The tilt of the trunk was five times more frequently away from the painful side than it was towards the side of the lesion. Occasionally we encounter an alternating sciatic scoliosis. The histories of these patients, which were unselected and form a cross section of our experience, indicated that the causes for the sciatic scoliosis were the following in the order from the most to the least frequent: lumbosacral sprain, lumbosacral arthritis, sacroilic sprain, myositis and myofascitis, sciatica, herniated disc, chondromalacia of intervertebral disc, vertebral epiphysitis, retroverted uterus and organic neurologic disturbance.

Sciatic scoliosis is only a symptom complex secondary to some definite pathologic condition. It cannot be used as a final diagnosis. When employed it must be accompanied with the diagnosis of the underlying cause. Thus one would speak of right or left or alternating sciatic scoliosis secondary to sprain of the sacroiliac joint, gluteal myositis, myofascitis, sciatica or herniated disc.

It is important to appreciate that in a chronic sciatic scoliosis from whatever cause adaptive secondary changes take place which tend to perpetuate the deformity. The presence of these changes is assumed from the fact that relieving them corrects the sciatic scoliosis. I refer to adaptive contractures which take place in the muscles of the back and perineural adhesions about the sciatic nerve in the affected limb. The proof of the pudding is in the eating. When the contracture of the muscles and the perineural sciatic adhesions are stretched, the deformity disappears and the symptoms are relieved. This fact is utilized in the treatment of patients with chronic sciatic scoliosis.

In speaking of the several causes of sciatic scoliosis it goes without the need for emphasis that a complete physical examination has excluded pathologic conditions in any of the body systems which might give rise to backache, particularly chronic arachnoiditis and cord tumors.

TREATMENT

The management of a case of sciatic scoliosis depends upon whether the symptom complex is acute or chronic. Under all circumstances a diagnosis of the basic disorder is the prerequisite for any and all treatment. In the acute phase rest and gentle physical therapy are most helpful. These may be supplemented by strapping of the back, wearing of a low back belt, corset or a plaster of paris jacket. If the symptoms are readily relieved, ambulation may be permitted. In the more severe types rest in bed on a hard surface with traction to one or both legs may effect a cure. In the severe, recurrent and chronic cases the patient should be hospitalized. Under anesthesia the back should be thoroughly stretched until the deformity is corrected and the normal physiologic curve of the spine, particularly the lumbar lordosis, has been re-established. The affected sciatic nerve should then be stretched by reflexing the limb at the hip with the knee in complete extension. This maneuver should be carried out very slowly. At least ten minutes should be spent in stretching the nerve. This type of manipulation has two dangers, namely, dislocation of the hip and rupture of the sciatic nerve. The first can be avoided by keeping the limb in abduction. The second may be averted by the exercise of judgment. In a young, thin individual one can readily bring the foot of the limb being stretched to within 20 inches of the face. In an older or stout person flexing the limb to a right angle with the trunk may be adequate. It is well to palpate the tissues in the popliteal area; and when they feel tense, the stretching is stopped.

The patient is then encased in a unilateral plaster of paris spicajacket. One places the patient on a hip rest using any of the modern orthopedic operating tables. The lower limbs are hyperextended at the hips until one can feel a normal lumbar curve. Six or seven thicknesses of sheet cotton are wound about the trunk and a plaster of paris jacket is applied. When this has hardened sufficiently, the lower limbs are brought into line with the trunk and the plaster of paris is continued down the affected limb to the toes holding the knee in slight flexion and the foot in slight equinus.

In the vast majority of cases when the patient awakens from the anesthetic, he volunteers the information that his old pain is gone. I would not be surprised but that in many of these cases a herniated disc slips back into its normal position through the described manipulation. It is certain that most patients get well. The plaster is left on for three weeks and is replaced by a Knight spinal brace. When the

plaster is removed, the patient is still kept in bed for a week or ten days while the brace is being made. During this time the patient is instructed in mild exercises for his back and leg. These he performs three times a day, increasing the number and strenuousness of the exercises gradually.

When the brace is finished, it is applied and the patient is permitted to sit up in bed or on a chair, then to stand and finally to walk. The patient's activity is increased slowly; and when he can get about freely, he is discharged to office care. Physical therapy in the form of baking and massage accelerates the recovery. The brace should be worn for three to six months and replaced by a low back canvas belt. The patient can usually return to his customary occupation, if it is not laborious, in about three months. In those who have to perform hard labor the convalescence should be prolonged at least six months.

SUMMARY

Sciatic scoliosis is a symptom complex arising from disorder in the lower back. This clinical syndrome is of frequent occurrence, being found chiefly in otherwise healthy individuals between twenty and fifty years of age. The most important problem in this syndrome is to identify and localize the essential causal pathologic lesion. Fortunately, the lesion is readily recognized by a careful history and a methodical examination. The vast majority of patients suffering from sciatic scoliosis can be relieved by conservative measures. Attention has been directed to the value of manipulation and stretching of the back and the affected sciatic nerve in instances of chronic sciatic scoliosis. The technic of the stretching has been described and is recommended because of the high per cent of complete recoveries. In the refractory cases of myositis and herniated intervertebral discs surgery can be utilized to obtain a cure.

ESOPHAGEAL INTUBATION FOR REPAIR OF PHARYNGO-ESOPHAGEAL DIVERTICULUM*

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SHALLOW and Clerf[5] discuss the operative technic of repair of esophageal diverticuli and present an improved technic wherein surgery is facilitated by the cooperation of an esophagoscopist throughout the surgical procedure. The advantages obtained are threefold, namely, emptying of the sac before surgery, aiding in identification of the diverticulum for the surgeon and maintenance of alignment of pharynx and esophagus during repair. The purpose of this article is to call attention to the fact that these endoscopic procedures may well be performed by the anesthesiologist within whose domain they may properly lie, together with the addition of a point in technic to aid in closing the defect, i.e., distention of the esophagus by a tube of sufficient caliber to simulate the stretching which takes place during swallowing.

The consistency of the site of origin of pharyngo-esophageal diverticuli[1–5] (constituting about 95 per cent of all diverticuli associated with the esophagus) is the anatomic feature which makes an intrapharyngeal approach to the sac readily available to the anesthesiologist. Specifically, the herniation occurs at the juncture of the inferior constrictor and cricopharyngeus muscles. (Fig. 1.)

Etiologically, the sac is presumed to form as a result of muscular incoordination,[2,3] ie., constrictors of the pharynx attempting to pass food by a spastic upper esophagus, with the result that the mucous membrane knuckles out posteriorly at the weak point at the junction of the two aforementioned muscles. Eventually, weight of food in the sac angulates it downward, displacing the esophagus to the left (most commonly) and placing the diverticulum directly in the path of the swallowed food. (Fig. 1.)

Repair of esophageal diverticuli, an exacting surgical procedure in itself, is made more difficult for the surgeon by the relative infrequency of the lesion. Any maneuver which will readily identify the offending sac is apt to not only shorten the procedure but also add to its safety. Further, once the esophageal defect is located, an additional hazard is encountered in that the enormously elastic esophageal wall, irregularly plicated in its relaxed state, offers little suggestion as to its disposition when distended. It is obviously desirable to provide some means of distending the esophagus such as will flatten out the plications during the repair. Moreover, Shallow and Clerf[5] point out the desirability of maintaining the pharynx and upper esophagus in their anatomic midline position during ligation of the sac neck and transplantation of the stump. To achieve this end they prefer to maintain an esophagoscope in the esophagus during the entire period of repair.

About fifty years ago, Kocher of Switzerland and J. S. Mixter of the United States observed the constant displacement of the esophagus produced by an enlarging diverticulum,[5] noting that a tube passed into the pharynx, when directed anteriorly and to the right, would bypass the diverticulum and enter the slit-like esophageal orifice. Likewise, when the tube was directed posteriorly and to the left, it would enter the diverticulum. As a matter of practical importance a large diverticular sac, opening as it does from the lower end of the pharynx, receives any tube directed toward the inferior pharynx. It is usually only with great difficulty that a tube may be induced to enter the narrowed esophageal orifice which has been displaced from the midline by the enlarging pouch.

The principles of Mixter and Kocher were used in intubating the diverticuli and esophagi of two patients previously described[6] as well as an additional case not previously reported.

TECHNIC

Following induction of anesthesia, with a minimal quantity of pentothal,® curare was injected in an amount sufficient for an atraumatic

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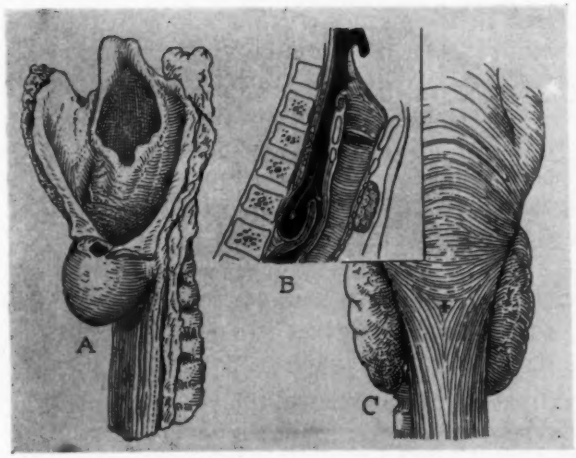

FIG. 1. Anatomic features of pharyngo-esophageal diverticulum. (Courtesy of Charles C Thomas, Publisher, Springfield, Ill.[4])

FIG. 2. Cameron surgical light.

exposure of the glottis. Under direct vision the esophageal diverticulum, with its orifice in continuity with the lower pharynx, was carefully aspirated of food content to eliminate tracheal aspiration from this source. Cocaine in 10 per cent concentration was then liberally sprayed over the pharynx and glottis under direct vision of the laryngoscope, employing an atomizer for this purpose. The small lamp on a flexible shaft* which is to illuminate the diverticulum for the surgeon was placed in the sac by directing its tip down the left posterior wall of the pharynx until gentle resistance was met. (Fig. 2.) Lastly the trachea was intubated and the patient was then ready for draping. Glottic intubation is reserved until last since the tracheal tube would obscure the hypopharynx and the orifice of the sac below it. In one of the patients a retching movement during laryngoscopy caused the hypopharyngeal sphincter to open widely, which presented a full view of both the sac and the slit-like true esophageal orifice.

When the surgical procedure has progressed to the point at which the superficial fascia has been opened thus exposing the structures of the neck, the light, which was previously placed, is turned on and brilliantly illuminates the diverticulum. The surgeon then proceeds to free the sac throughout its extent. However, before the diverticulum is cut from its parent structure, the light is withdrawn and the esophagus blindly intubated by directing a large Magill tube anteriorly and to the right, down the pharynx. At this point the surgeon is in an advantageous position to facilitate the traversing of the small, slit-like esophageal orifice by gentle manipulation of the now delineated structures. The tube need be passed but 3 or 4 inches beyond the orifice to anchor these structures for maintenance of their anatomic position, thought to be of major importance in accurate repair by Shallow and Clerf.[5]

Obviously, the greatest care must be exercised to secure the tube against loss into the stomach since recovery would constitute a major procedure.

* Manufactured by the Cameron Surgical Specialty Co., Chicago, Ill.

COMMENTS

Several factors are to be considered specifically in the management of anesthesia for esophageal diverticula, namely, danger of aspiration of diverticulum content, trauma to recurrent laryngeal nerves and facilitation of sac identification for the surgeon.

Regional block anesthesia (advocated by Harrington[1] and formerly by Lahey[3]) fulfills all three requirements in that (1) the swallowing reflex is maintained to guard against aspiration, (2) talking during the dissection offers information as to the state of the laryngeal nerves and (3) the patient is usually able to fill the diverticulum with air by swallowing and thus aid in its identification. However, Lahey[3] has discontinued regional block anesthesia for this procedure after reporting its use in 118 cases, stating that it is a trying ordeal for the patient and "sometimes far from satisfactory even in competent hands."

General anesthesia, with a cuffed tube in place in the trachea, protects against aspira-

tion. With the technic used here it assists in location of the diverticular sac. Although general anesthesia fails in respect to the third point, offering no protection against laryngeal nerve damage, it must be noted that in one large series of patients[1] operated upon exclusively under regional block (140 cases) there were six temporary cord paralyses and one permanent paralysis, suggestion that regional anesthesia in itself does not guarantee the integrity of the laryngeal nerves.

ESOPHAGEAL INTUBATION

Knowing that the distensibility of the esophagus permits passage of a food bolus of tremendous size, one may appreciate the difficulties of accurately closing a rent in its wall while the esophagus is in the relaxed state. Swallowing in the immediate postoperative period places great stress upon the suture lines. As might be expected from these features, the principal complications of this surgery result from leakage at an unsatisfactory closure. These are the following: *recurrences, fistula formation* and *obstruction*. In the series of 140 patients referred to previously,[1] temporary fistulas developed in eleven, angulation requiring dilatation in ten and recurrences in five. Others[3,4] observe similar complications, and so frequent is postoperative obstruction it has been recommended[1] that a string be left in the esophagus to aid in dilatation at a later date. The virtue of esophageal intubation is twofold. First, maintenance of the normal anatomic position of the pharynx and esophagus eliminates the distortion produced by a long present large diverticulum during the actual repair. Second, in distending the esophagus itself suture lines may be placed in the tissues corresponding to the disposition taken by the esophagus during swallowing, thus reducing the likelihood of stress during immediate postoperative swallowing. By esophageal intubation it is hoped that the chief cause for postoperative complications (ie., unsatisfactory apposition of edges of the sac neck) can be largely eliminated.

SUMMARY

Using technics familiar to his specialty, the anesthesiologist is able to assist the surgeon greatly in the repair of pharyngo-esophageal diverticula by the following: (1) providing positive identification of the diverticulum sac and (2) anchoring and distending the esophagus during coaptation of its cut edges, permitting a more anatomic closure, and reducing thereby, it is hoped, postoperative complications.*

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*Until the time of publication this technic has been used in five instances, each time with gratifying results.

APPENDICITIS IN THE AMERICAN NEGRO*

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IN 1936 Maes[12] stated, "taking case for case (of appendicitis), the Negro, ill the same length of time as the white patient, tends to exhibit a severer and more advanced type of disease." At that time, since no adequate series of appendicitis regarding the Negro had been published, it was decided to follow carefully appendicitis in the American Negro at Freedmen's Hospital for a ten-year period. This study covers the period from January 1, 1938, to December 20, 1948. In it are reviewed 1,200 cases of histologically proven appendicitis.

TABLE I
ALL CASES OF ACUTE APPENDICITIS

Group	Classification	1938–1943		1943–1948		1938–1948	
		No. Cases	Mortality (Per cent)	No. Cases	Mortality (Per cent)	No. Cases	Mortality (Per cent)
I	Uncomplicated	443	0.68	525	0.00	968	0.31
II	Complicated	102	14.71	130	5.47	232	9.5
	Totals	545	3.22	655	1.07	1,200	2.08

The purpose of this paper is to compare the results of this series with other series reported in the literature to ascertain, if possible, the role of race in appendicitis. The reports of Maes,[12] Tashire and Zinninger,[25] Giles,[8] and McCown[13] are reviewed specifically because their series analyze appendicitis in Negroes. During this period there have been over fifty different operating surgeons representing all levels of the house staff.

Our classification of appendicitis is based on the histologic diagnoses made by the Department of Pathology of the Howard University College of Medicine. The entire series has been divided into two main divisions, namely, Group I, uncomplicated appendicitis and Group II, complicated appendicitis, as listed in Table I in which the ten-year period is divided into two five-year periods to denote the progress that has been made at Freedmen's Hospital.

There were twenty-five deaths in 1,200 cases of acute appendicitis and associated lesions or a mortality rate of 2.08 per cent. For the years 1943 to 1948 the mortality rate for 655 cases was 1.07 per cent. Our lowest rate was in 1946 with no deaths. Only one death occurred in 163 cases in 1947, a mortality rate of 0.61 per cent. Jennings,[10] Rogers[20] and Slattery[23] reported mortality rates of 1.0, 3.06 and 5.1 per cent, respectively, in their series similar to those in Table II.

Over 70 per cent of our entire series presented a fairly typical "textbook" picture of appendicitis on entry to the hospital. In the cases with gangrenous appendicitis, chills were associated in 40 per cent.

GROUP I—UNCOMPLICATED APPENDICITIS

The subdivisions of uncomplicated appendicitis are (1) acute catarrhal appendicitis, (2) subacute or internal appendicitis and (3) acute suppurative appendicitis with localizing peritonitis.

Acute catarrhal appendicitis includes almost one-quarter (23.6 per cent) of the total number. There was one death, a mortality rate of 0.35 per cent. During the last five years there were no deaths. Subacute or internal appendicitis contains 496 cases (41.4 per cent), with two deaths resulting in a mortality rate of 0.40 per cent. Both deaths occurred in the first five-year period.

In combining classifications 1 and 2, the series contains 779 cases, with three deaths or a mortality rate of 0.38 per cent for the ten-year period. During the last five years there were 431 cases, with no deaths. This series compares very well with those reported by others.[1,14,22,25] Stafford,[24] Burke,[5] Rumbold,[21] Rogers[20] and Slattery[23] also presented series comparable to the latter.

* From the Department of Surgery, the College of Medicine, Howard University, and the Surgical Service of Freedmen's Hospital, Washington, D. C.

In acute suppurative appendicitis with localizing peritonitis there were 189 cases (15.7 per cent), with no deaths for the entire ten years.

GROUP II—COMPLICATED APPENDICITIS

The subdivisions of complicated appendicitis are (1) acute gangrenous appendicitis with localizing peritonitis, (2) acute gangrenous appendicitis with rupture and/or abscess, (3) acute suppurative appendicitis with rupture and/or abscess and (4) acute appendicitis with generalized peritonitis.

Acute gangrenous appendicitis with localizing peritonitis includes sixty-six cases, of which there were three deaths or a mortality rate of 4.55 per cent. In the last five years there was one death in forty cases, a mortality rate of 2.5 per cent.

There were 255 cases of acute appendicitis with localizing peritonitis in the ten-year period with three deaths or a mortality rate of 1.18 per cent. For the last five-year period the mortality rate was 0.75 per cent in 134 cases. Other comparable series are reported in the literature.[1,22] Bohmannson,[2] Nassau,[16] Rumbold[21] and Slattery[23] reported mortality rates of 11, 3.5, 7.1, and 5.9 per cent, respectively, in their series of acute appendicitis with local peritonitis.

In acute gangrenous appendicitis with rupture and/or abscess there were fifty-one cases in this group or 4.2 per cent of the entire series, of which four died, a mortality rate of 7.84 per cent. Two of these deaths occurred in the thirty-three cases during the last five years, a mortality rate of 6.67 per cent. In acute suppurative appendicitis with rupture and/or abscess the mortality rate, based on five deaths in this group of seventy-nine cases, was 6.33 per cent. Only one death occurred during the last five-year period, a mortality rate of 2.78 per cent.

In combining all cases with rupture and/or primary abscess, there were seven deaths in 117 cases, a mortality rate of 6.0 per cent. Three of these deaths occurred in the last five years in the seventy-three cases, a mortality rate of 4.1 per cent. Other series of appendiceal abscess should be referred to for comparison.[1,4,22,25] Bryce,[3] Reid,[18] Stafford[24] and Rumbold[21] report mortality rates of 10.8, 10.0, 7.06 and 18.4 per cent respectively, in their series with abscess formation.

In acute appendicitis with generalized peritonitis, ten of the thirty-six patients in this group died.

This gives a mortality rate of 28.0 per cent. Progressive fibrinopurulent peritonitis was found in 75 per cent of the cases. During the past five years there were only three deaths in twenty-one cases, a mortality rate of 14.29 per cent, but there have been no deaths in the fifteen cases since June, 1944. In comparison, Schullinger[22] reported a mortality rate of 40.08 per cent in diffuse peritonitis, but 80.0 per cent in fifty-four cases of progressive fibrinopurulent type from 1941 to 1946.

In all of the cases in this category intravenous fluids were given preoperatively, including whole blood, to correct dehydration, electrolyte imbalance and shock. In addition,

TABLE II

TOTAL MORTALITY RATES OF CASES OF ACUTE APPENDICITIS AND ASSOCIATED LESIONS REPORTED IN LITERATURE

Authors	Place	Period Studied	No. of Cases	Mortality (Per cent)
Hathaway and Watkins[9]	Cleveland Survey, O.	1930–1942	19,401	4.8
Aycock and Farris[1]	Baltimore City Hospitals, Md.	1935–1944	31,151	3.0
Mueller[15]	Roosevelt Hospital, N. Y.	1935–1944	1,481	1.6
Tashire and Zinninger[25]	Cincinnati General Hospital, O.	1939–1943	936	3.3
Robbins[15]	U. S. Naval Hospital	1942–1945	2,404	0.24
Schullinger[22]	Presbyterian Hospital, N. Y.	1941–1946	1,142	1.37
Ford and Drew*	Freedmen's Hospital, Washington, D. C.	1938–1948	1,200	2.08
		1943–1948	655	1.07

* Present series.

antibiotics and sulfonamides were given when available as indicated.

The factors largely responsible for the decrease in the operative mortality of appendicitis seem to be earlier hospitalization, greater knowledge of electrolyte balance and avoidance of outmoded technics.

The use of cathartics, as in eight of the twenty-five cases in which the patients died, the type of appendicitis, age of the patient (eight of one series were over sixty) and delay of hospitalization are still factors which tend toward a higher mortality.

Maes[12] stated that while "the Negro furnished less than one-quarter of the 4,157 cases of acute appendicitis, they furnished more than one-third of the deaths, 13.4% to 6.18% for the whites." Tashire and Zinninger[25] noted in their series thirteen deaths in 244 cases (5.2 per cent) for Negroes and eighteen deaths in 692 cases (2.6 per cent) for white patients, with an over-all mortality of 3.3 per cent. They also noted that perforations were 11 per cent more common in the Negro. Their total number was over 25 per cent of the cases as compared to 13.6 per cent in the series in this study. McCown[13] reported a series of 108 consecutive cases of appendicitis in Negroes at Fort Livingston, Louisiana, without a single death. Giles[8] reported a similar series of 342 cases in the army at Fort Huachua with no deaths, all were Negroes. These patients were for the most part young, able-bodied men. Lewis[11] in his book, "The Biology of the Negro," states, "Deaths from appendicitis according to most American statistics, appear to be higher in Negroes than in whites; among Native Africans, appendicitis is often believed not to occur. . . Pales[17] says the relative proportion of appendicitis in native Africans and whites is about 3 to 10. . . In South Africa, Erasmus[7] says that appendicitis is eight times more frequent in Europeans than in the Bantu although complications occur more often in the latter."

SUMMARY

An analysis of 1,200 cases of pathologically diagnosed appendicitis in the American Negro at Freedmen's hospital for a ten-year period has been presented.

The total mortality rate for all cases of appendicitis for the ten-year period is 2.08 per cent. During the second five-year period the mortality rate was only 1.07 per cent in 655 cases.

There has been no mortality from uncomplicated appendicitis in the last five years in 525 cases, and a 0.31 per cent mortality for the entire ten years.

In complicated appendicitis the ten-year mortality rate for 232 cases is 9.5 per cent, which has been reduced to 5.4 per cent for 130 cases in the latter half of the period. Over one-third of the deaths were in the aged (over sixty years).

Our findings suggest that the mortality and the morbidity of appendicitis vary with the skill and care with which the patients are treated. Race, *per se*, seems to play little or no role. Time of diagnosis, type of appendicitis, preoperative delay and age of the patient do have very important roles in the final outcome.

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Colored women especially are apt to have lymphogranuloma venereum if the surgeon encounters such patients with rectal strictures. These patients have diarrhea, abdominal distention and pain, secondary anemia, moderate leukocytosis, low plasma proteins with often a reversal of the albumin-globulin ratio, and a positive Frei test. After such patients are "built up" for about a week, a defunctioning colostomy is done. Half a year later the diseased area of the rectum is excised, through a sacral incision, and the healthy bowel on each end is anastomosed. Some two months after this posterior incision is healed, the old colostomy opening can be safely closed. Postoperative results are excellent and operative mortality should be minimal. (*Richard A. Leonardo, M.D.*)

Streamlined Articles

RINCON METHOD OF STERILIZATION

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THE desirability of sterilizing certain women is a universally accepted fact. Often the desirability becomes a necessity for the preservation of the health and even the life of the patient. The indications for sterilization are numerous, and it is granted that many of them are debatable. Much of the disagreement over the indications for sterilization among gynecologists and obstetricians is based upon individual medical experience and much of it is colored by religious and moral views. It is not the purpose of this paper to enter into the controversy regarding indications. It is assumed that even the most conservatively minded gynecologist and obstetrician will on occasion be faced with the necessity of sterilizing a patient. The object of this article is to present a new technic which is rapid, efficient and does not interfere with the blood supply to the ovaries; 1,284 cases of operative sterilization are reported without a failure.

* * * *

Methods of sterilization are numerous and all have their proponents. Nevertheless, it has appeared to us that all of the methods in general use today have certain shortcomings which do not exist in the method to be described. Perhaps the four most commonly used technics today are the Pomeroy, Irving, Madlener and cornual excision methods.

In brief the Pomeroy operation for tubal sterilization is performed as follows: One tube is delivered through an abdominal midline incision. The tube is held up and crushed with an Ochsner clamp. It is then ligated with No. 2 chromic catgut and the loop is severed with scissors. The process is duplicated on the opposite tube.

In the Irving technic the tube is transected between two ligatures of No. 0 catgut which have been placed approximately 3 cm from the uterine cornu. The proximal tube is mobilized by dissecting it free from the mesosalpinx. It is then buried in the musculature of the posterior uterine wall and sutured in place. Next the ligated end of the distal portion of the tube is buried between the leaves of the broad ligament which are then closed with interrupted sutures. The procedure is duplicated in its entirety on the opposite side.

In the cornual resection for sterilization the tube is transected 1 cm. from the uterine cornu. The proximal portion of the tube is dissected free from the mesosalpinx and excised from the uterine cornu together with a small wedge of uterine musculature. The wound is closed with No. 0 chromic catgut. The distal end of the tube is next buried between the leaves of the broad ligament. In conclusion the round and broad ligaments are brought over the cornu for the purpose of peritonealization.

The Irving and cornual resection operations are time consuming and cause a certain amount of bleeding. This latter consideration becomes of paramount importance in the postpartum patient, on occasion it has become necessary to perform a hysterectomy in order to control bleeding in a postpartum patient upon whom a cornual resection was attempted. In certain cases it is impossible to peritonealize all raw surfaces thereby greatly enhancing the possibility of adhesion formation. In isolated instances operative intervention has become necessary to correct intestinal obstruction due to adhesion formation following sterilization by the cornual resection method. There is a case on record at the Johns Hopkins Hospital of intestinal obstruction followed by lethal exitus which was caused by an adhesion

formed at the site of a previous cornual resection.

The Pomeroy technic circumvents the undesirable features just described, but there is a deplorable failure of sterilization in certain instances. Articles report an incidence of failure in the technic as one failure in fifty cases[1] and as low as 223 cases without failure.[2] The failures are usually due to recanalization of the severed ends of the tubes at the site of the tightly tied gut which sloughs through the tube. Fox[1] admirably describes such a failure of sterilization which occurred one year after a Pomeroy operation, and he presents microscopic sections demonstrating a small epithelium-lined sinus open to the peritoneal cavity and continuous with the tubal lumen. The Pomeroy technic is used exclusively on the Obstetrical Service at the Johns Hopkins Hospital. During recent years this service has had several failures of sterilization due to the aforementioned cause. An occasional failure has been reported due to ligation of the round ligament instead of the fallopian tube. (One of the failures at the Johns Hopkins Hospital was due to this cause. Microscopic examination of the removed piece of so-called tube revealed round ligament.) Lastly, some of the blood supply to the ovary may be interrupted by the ligature; and although it is not accepted by many that this is a reason for the formation of polycystic ovaries, it is not irrefutable that such a possibility exists.

In the Madlener technic the base of a loop of the tube is crushed and ligated with silk. This simple procedure is repeated on the opposite tube. The Madlener technic embraces all the imperfections of the Pomeroy technic combined with an even greater incidence of pregnancy following attempted sterilization.

In view of the fact that pregnancy occurred once in every ninety-eight cases following attempted sterilization utilizing the Pomeroy technic at the Ryder Memorial Hospital, Puerto Rico, it was decided to initiate a more successful method.

TECHNIC

In this method of sterilization the abdomen is entered in routine fashion through a small (1¼ to 1½ inches) incision made in the midline below the umbilicus. The lateral portion of the postpartum uterus is pushed toward the midline with a finger retractor and the respective fallopian tube is grasped with a sponge forceps at its intermural portion. If this particular portion of the tube is grasped, considerable traction may be made without danger of pulling the tube from the uterus. The remainder of the tube is pulled into view until the ostium is seen and grasped with a second sponge forceps. This not only exposes the tube but also eliminates all possibility of making the mistake of ligating the round ligament. Von Graff[3] reports failure of sterilization due to mistaking the round ligament for the fallopian tube when the Madlener technic had been attempted.

A mosquito clamp which grasps a ligature of No. 2 deknatel is thrust through the mesosalpinx at a point near the ostium. The ligature is released and left *in situ* while the mosquito clamp is withdrawn from the mesosalpinx, clamped over the tube and left in place. The same procedure is repeated at the mid-portion and again at the proximal portion of the tube. It should be emphasized that the final deknatel ligature should be placed in an avascular area as close to the uterus as possible. These ligatures should occupy a position between the ovarian branch of the uterine artery and the tube so that the vessel or any of its larger branches is not included when the ligatures are tied over the tube. If this vessel is occluded, a polycystic ovary might result from diminished blood supply to the ovary.

As each of the three mosquito clamps is removed, the respective ligature is tied in the crushed area. The deknatel ligatures have the advantage of being of large diameter and therefore do not cut through the tube as readily as fine silk, cotton or gut. As was already stated, fertilization through a fistulous tract left after a ligature had cut through a fallopian tube is relatively frequent following attempted sterilization utilizing the Pomeroy and Madlener technics. It is advisable to tie the No. 2 deknatel ligatures firmly but not too tightly. The tube is next transected between the two distal ligatures and the transected ends are tied with No. 50 cotton. No peritonealization is necessary. (Fig. 1.) A similar procedure is carried out on the opposite fallopian tube.

RESULTS

Since 1936, 1,284 patients have been sterilized with this method of operative sterilization. Two of these patients have become pregnant. The failure in these patients does not reflect

FIG. 1. A mosquito clamp which grasps a ligature of No. 2 deknatel is being thrust through the mesosalpinx. The same clamp has been withdrawn from the mesosalpinx, clamped over the tube and left in place. On the left side the three No. 2 deknatel sutures are tied in place and the tube is being transected between two clamped mosquito clamps. The opposite side of the drawing demonstrates the completed operation. The three deknatel sutures have been tied in place, the tube transected between the two distal ligatures and the transected ends have been tied with No. 50 cotton.

on the operative technic advocated. In one case the surgeon had not mastered the operation and failed to transect the tubes. This serves only to emphasize that three ties are not sufficient for adequate sterilization and that transection is of paramount importance. The second case was not one of postpartum sterilization. The patient admitted sexual intercourse during the entire week previous to the operation. The baby, weighing 3,500 gm., was delivered 264 days after operation. We believe that the patient was pregnant before the operation. Since that time all non-postpartum patients have been operated upon during the last day of menstruation. Certainly the sterilization procedure could hardly be expected to terminate pregnancy in a previously impregnated uterus.

The usual operating time is ten minutes. There has been no mortality. The sole complication has been stitch abscess and this has been infrequent. The usual postpartum hospitalization is five days. In those patients who were not postpartum the appendix was always removed.

COMMENTS

The advantages accrued by the Rincon method of sterilization are as follows: (1) In our hands this has been the most effective method of operative sterilization to be used. The Rincon operation has been performed upon over 1,000 patients without a single failure of sterilization. (2) The simplicity of the procedure allows for speed in completion of the operation. (3) It is a very small incision. Upon occasion this type of operation has been performed through the vaginal route; however, it is preferable to perform it through the abdomen so that if a complicating pathologic condition is noted it may possibly be rectified during the same operation. (4) No bleeding occurs except that encountered when cutting through the skin and fat of the abdominal wall. (5) The large, non-absorbable sutures of deknatel do not cut through the tube with as much ease as the finer silk, cotton or gut, and as already depicted, this lessens the chance of fistula formation at the point of ligature. (6) There is no interference with the ovarian blood supply. Bishop[4] reports that polycystic ovary may develop following interference with the blood supply to the ovary. When the Pomeroy technic is used, some of the blood supply to the ovary is ligated.

Upon comparing the statistical results of the Rincon operation with that obtained by other types of sterilization operations it is imperative

to consider that all our patients were young, fertile females.

Kopp[6] reported a study of 10,000 case histories from a New York clinic and found 11,172 abortions as compared with 27,813 confinements in a total of 38,985 pregnancies, a ratio of one abortion to 2.5 confinements.

The statistics of abortion in the indigent people in Puerto Rico are not known. However, the usual history given by a woman in her middle twenties who belongs to this group is that of having five to ten children without abortion. We have not infrequently encountered women with fifteen children and no abortions; nor is it unusual to see a patient who has had five or more children in such rapid succession that she will not have menstruated in as many years.

Most of the reports of success of sterilization heretofore have dealt with a relatively nonfertile group (patients who have a chronic disease which is severe enough to endanger life if the burden of pregnancy were added). Other reports include patients who are approaching the menopause. Hewitt and Whitley[7] report that the percentage of failure of operative sterilization decreases as menopause is approached.

The follow-up on our patients may be considered as approximately 100 per cent. All the patients sterilized were poverty stricken. Additional children would have meant that there would not have been food enough for all the members of the family. Under these appalling conditions it can be assured that the patients would immediately present themselves to the hospital with vindication if they became pregnant.

Many of the people in the low economic group populating a large city in the United States migrate into the city to work for a time and are treated at the city hospitals. They later return to their rural homes which might be many miles away. These people, of course, do not present themselves to the hospital in the event they become pregnant. The patients that we treated live and die within the confines of the small island of Puerto Rico. For this reason, our so-called follow-up may be considered very close to 100 per cent.

There is controversy in the literature as to the proper time for sterilization. In our postpartum cases the patients were operated upon from several hours to five or six days after delivery. Some of the cases were not postpartum. We could not observe that the time of operation made any difference in the mortality, morbidity or results of sterilization.

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FURTHER OBSERVATIONS ON THE CLINICAL VALUE OF CHOLANGIOGRAPHY

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SATISFACTORY cholangiograms are always possible after operation and should always be made. These can be made by means of either a one-way or two-way T tube in the common duct, a catheter in the cystic duct following cholecystectomy or a small mushroom catheter in the gallbladder. The surgeon should therefore always leave the patient so prepared for postoperative cholangiography. Because the common bile duct and the ureter and kidney pelvis are both thin and long ductal structures with pliable walls whose pathologic conditions have much in common (calculus, malignancy, stricture), well taken and properly interpreted cholangiograms should compare very favorably with the best pyelograms whose diagnostic value is well regarded. Single and fluoroscopic interpretations are not as satisfactory as those which are made from serial exposures and/or those made during the injection of dye. These technics should be routine in all cases (Group v). Oblique pictures are also of great value in many instances. Cholangiography is a "must" procedure in all operative cases of acute cholecystitis (Group II).

* * * *

Although the recent literature concerning cholangiography indicates that the clinical and practical value of this diagnostic procedure is becoming better appreciated, it seems that its true worth is still not generally recognized. In reality such studies can be as accurate and as satisfactory as are those of gastrography, urography and cholecystography. Because the normal common bile duct like the normal ureter and kidney pelvis is thin and pliable, cholangiography can be compared particularly with retrograde pyelography whose clinical value is well known. In further comparison the pathologic conditions found in the extrahepatic biliary system are similar to those found in the urinary system and, because of their very nature, are likely to produce x-ray defects (e.g., calculus, stricture, malignancy).

By presenting a short series of "example" cholangiograms and briefly discussing their clinical significance, this paper will attempt to show that operative and/or postoperative x-ray studies of the biliary ductal system are always of clinical value and that their careful interpretation will often increase the incidence of correct diagnoses and therapy. (Negative findings are of as much import as are positive ones.)

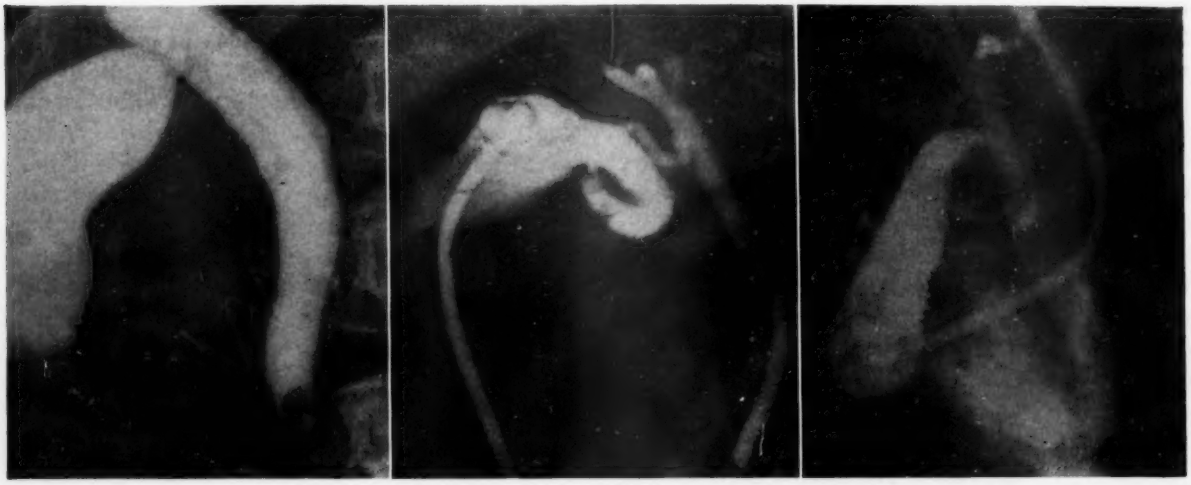
TECHNIC

Postoperative. The patient should be comfortable on the table and the examiner should have a good idea of the probable pathologic condition for which the x-ray is being done, i.e., whether it may be in the proximal or distal duct.

The duct should first be cleansed as well as possible by barbotaging with warm saline and then emptying it. This leaves the minimum of artefact-producing material in the duct. The patient is centered on the table either under the fluoroscope or by examining a plate after the injection of 1 cc. of 35 per cent diodrast. When the patient is in the satisfactory position, several further injections of 2 cc. each are made. These plates should be examined before more are taken. This allows one to pay particular attention to any doubtful area and to see a negative shadow before it may be obliterated by complete filling of the lumen. For example, if the lower (pancreatic) end of the duct lies over the border of the vertebral column and is not clearly seen, the patient should be turned to the right oblique position. The final pictures are then taken in this position *as the dye is being injected* thus producing the maximum and true dimensions of the duct, particularly the distal segments. This technic and the *serial exposures are necessary for the surest interpretations just as are serial exposures in a "gastric*

1A 1B 1C

FIG. 1. Group I; normal cholangiograms. A, the cystic duct joins the common hepatic duct on the medial side; a small ductal system in a short man; B, cholecystostomy for acute edema of pancreas; C, short, narrow, tortuous cystic duct which probably explains some cases of non-calculus colic.



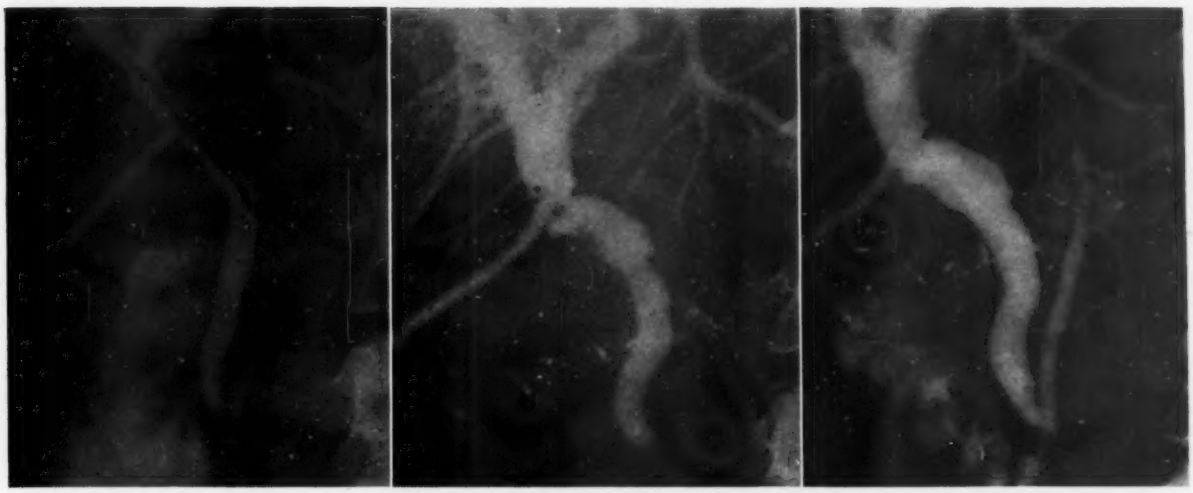
2A 2B 2C

FIG. 2. Group II; postoperative cholangiograms concerning acute cholecystitis. A, a single calculus in the common bile duct following drainage of a dangerously removable gallbladder; B, normal duct following drainage of bladder; C, the common duct is clear and the calculus obstructing the cystic duct is clearly seen.

series" (Group V). Diodrast (35 per cent) has been found to be the best medium. It is non-toxic and gives the clearest outline of all substances used. In some thin patients a 17.5 per cent solution is quite satisfactory and is more likely to reveal negative shadows. This is prepared by mixing equal parts of normal saline or distilled water and the 35 per cent preparation. Diodrast, 70 per cent, is too opaque as is lipiodol.

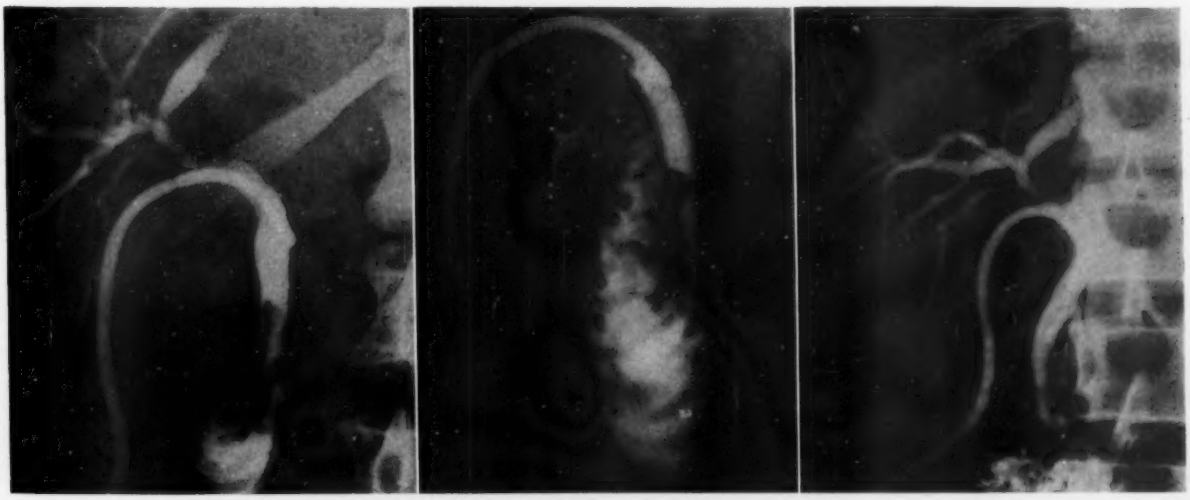
If pictures are not satisfactory at the first taking, they should be repeated forty-eight to seventy-two hours after the patient has had more active movement in the biliary area by coughing, deep breathing, exercise and further irrigation of the ductal system. This activity will probably change the position of negative shadow factors and either prove or disprove the presence of calculi whose shape and contour do not change unless they fragmentize.

Operative. Although the ideal time to discover the presence or absence of common duct



3A 3B 3C

FIG. 3. Group III. A, normal postoperative cholangiogram; B, following removal of T tube. There is an obstruction at lower end of duct. The convexity faces the end of the duct. This is not a calculus which will produce a concavity defect as seen in Group II (A); dye does not enter the bowel and the ducts are much dilated; C, the pancreatic duct is filled, only a small amount of dye enters the duodenum and the obstructing agent is clearly seen as a negative shadow which has changed shape and is rough in outline. This is a mucus plug which was dissolved or dislodged by continuous perfusion with hot fluids (120 degrees) and caroid powder.



4A 4B 4C

FIG. 4. Group IV. A and B, a twenty-four year old female; cholecystectomy and no indications for exploring common duct. Routine insertion of catheter in the cystic duct; a flat triangular shadow is seen; C, absence of shadow. This followed injections of equal parts of ether and alcohol (1 cc.) at two-day intervals for two weeks. However, this is not recommended as a routine procedure. A two-way T tube reduces pain to a minimum. Calculi can be present in a grossly normal duct.

disease is on the operating table, we have found that immediate or operative cholangiography is not as practical or accurate as the delayed or postoperative studies. However, Wall reports very good results and it seems to be only a matter of time until the correction of technical details allows operative cholangiography to be a routine procedure. When satisfactory and trustworthy results are always obtainable, it will be the method of choice.

We are now doing biliary operations in the "cystoscopic" room using a Young table. This allows the use of a Bucky diaphragm and a stronger x-ray unit. The results thus far are much better than previous results and compare very favorably with the postoperative pictures.

EXAMPLE CHOLANGIOGRAMS

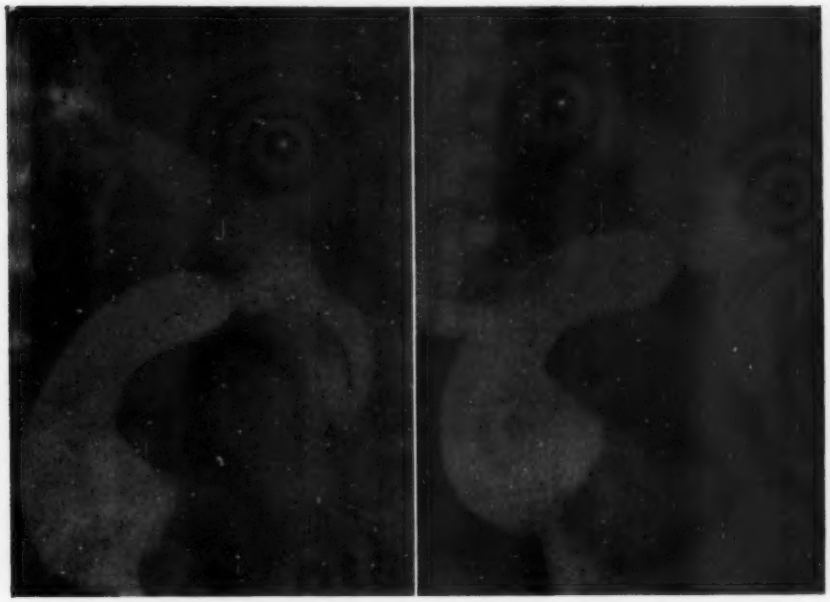
Group I. In Figure 1 can be seen the non-dilated "intra-hepatic" radicals, the clear out-

5A 5B

FIG. 5. Group V; Series 1. A, this single picture strongly suggests a calculus obstruction while (B) shows clearly that the lumen is unobstructed. These are consecutive pictures taken within seconds of each other; B, taken *during* the injection of the dye.

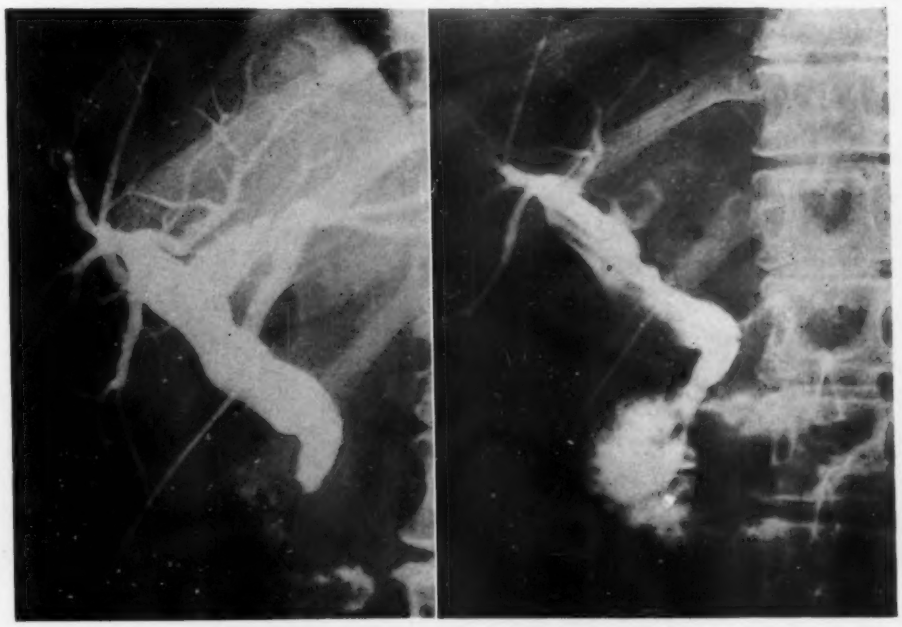
6A 6B

FIG. 6. Group V; Series 2. The contour of the terminal end of the duct changes with different intraductal pressures of the dye. These are also consecutive pictures taken as in Series 1, i.e., the last exposures are made as the dye is being injected. Diagnosis in (A) was a calculus; this was wrong. Diagnosis in (B) was fibrosing pancreatitis; this was correct.



7A 7B.

FIG. 7. Group V; Series 3. A, shows that the gallbladder cannot be used for a future anastomosis if the pancreatic disease should obstruct any more of the common bile duct. A single exposure as in (B) might have been interpreted as a short cystic duct making free communication with the common duct thus encouraging cholecysto-anastomosis.

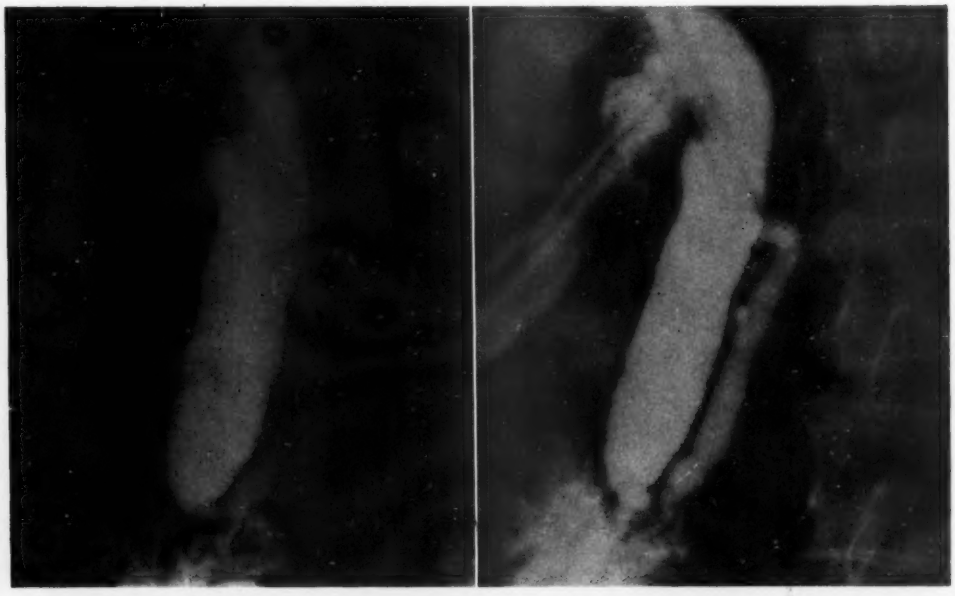


8A 8B

FIG. 8. Group V; Series 4. A, shows a normal-appearing duct. However, as the dye is withdrawn by syringe and the patient slightly turned, a negative shadow is well shown in the left hepatic duct (B). This would not have been suspected if the final interpretation had been made on the filled duct picture as seen in (A). Pictures should have been made on the operating table and would have revealed three faceted calculi in the intrahepatic part of the duct.

9A 9B

FIG. 9. Group VI; Series 1. A and B, show different outlines of the ampullary area. Even large amounts of dye are unable to dilate the hepatic radicals because they are surrounded by non-compressible cirrhotic tissue.



10A 10B

FIG. 10. Group VI; Series 2. A and B, diffuse nodular fibrosing pancreatitis. The termination of the greatly dilated pancreatic duct and the common bile duct seem to enter the duodenum separately in (B). However, in (A) the common duct is seen crossing under the pancreatic duct at right angles and is greatly compressed as it curves to enter the duodenum. Autopsy, which followed a pulmonary embolus, revealed that the pancreatic duct did not communicate with the common duct as suggested in (B).

11A 11B

FIG. 11. Group VI; Series 3. A, carcinoma of the proximal common hepatic duct; note the dilated intrahepatic bile ducts resulting from the obstruction; B, cholangiogram one week following the repair of a three month old stricture. Cholecystectomy performed elsewhere; arrow indicates slight leak at line of anastomosis. Note the two-way T tube which was used for continuous perfusion.

line of the duct with an absence of intra- or extraluminal pressure, the absence of negative shadows within the lumen and the clear view of the pancreatic portion of the duct. This area is most important and must always be seen, particularly if there is a history of jaundice, whether or not the rest of the biliary tree appears normal.

Group II. When surgery is the therapy of choice for acute cholecystitis and its complications, it may not on occasion be wise or possible to remove the bladder. Thus a second operation for cholecystectomy plus other procedures necessary for cure is often required. The advantages of knowing at the time of this later operation whether the common duct contains one or more stones and their probable location, the anatomy of the ductal area and the maximal intraluminal width of the pancreatic part of the duct are obvious. A large percentage of patients with acute conditions do have calculi in the common bile duct without clinical evidence other than that discovered in the cholangiograms. (Fig. 2.)

Group III. If the cholangiograms in Figure 3 were not taken, the correct diagnosis would not have been made, even at operation.

Group IV. Figure 4 illustrates the clinical value of routine cystic duct intubation at cholecystectomy.

Group V. Figures 5 to 8 illustrate the necessity of making serial exposures for the correct readings of calculus-like shadows and the fallacy of making a diagnosis from a single exposure.

Group VI. Figures 9 to 11 illustrate pictures of more than average clinical interest.

Acknowledgment: Appreciation is expressed to Dr. G. T. Zumstein, Director of the X-Ray Laboratories, and to his staff, Miss Jean McLean, Mr. Anthony Stechyshyn and Mr. H. Ralston. Appreciation is also expressed to the following doctors for the privilege of illustrating some of the cases: Dr. A. H. Greenwood, Dr. W. H. McMillan, Dr. John Sheahan, Dr. G. Weaver, Drs. Lloyd and Hilda Werden and Dr. E. Hunt.

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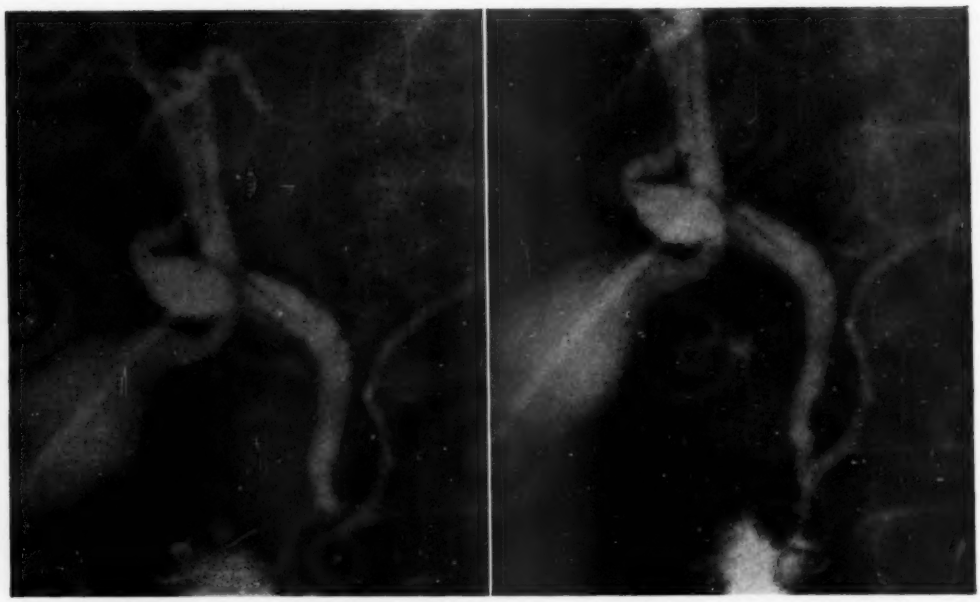
2. Idem. Routine cystic duct drainage following cholecystectomy. *Ann. Surg.*, 118: 97–100, 1943.
3. Idem. A. Two-way T-tube for continuous and heated post-operative perfusion of the biliary tree. *Canad. M. A. J.*, 62: 481–484, 1950.
4. WALL, W. Personal communication.



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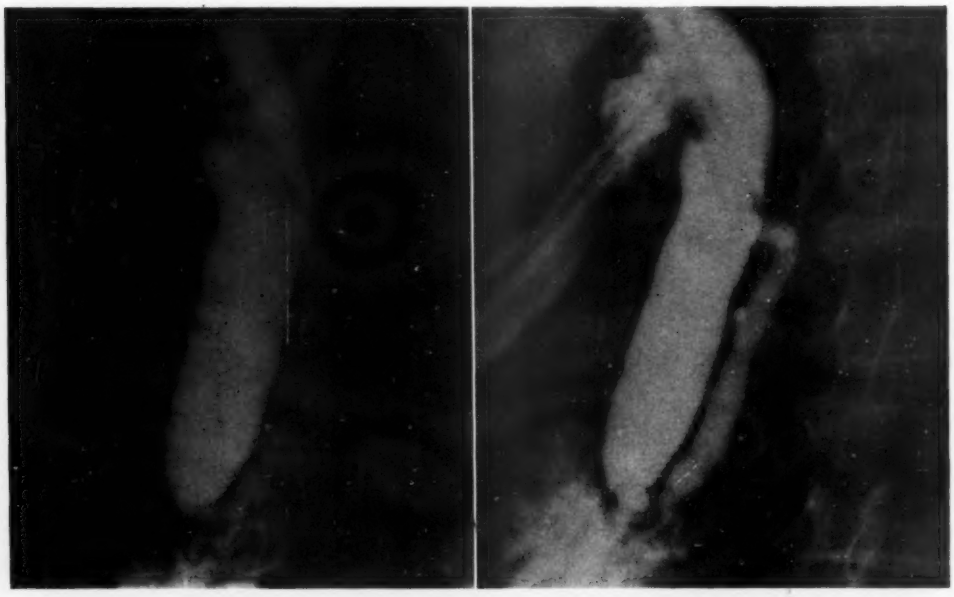

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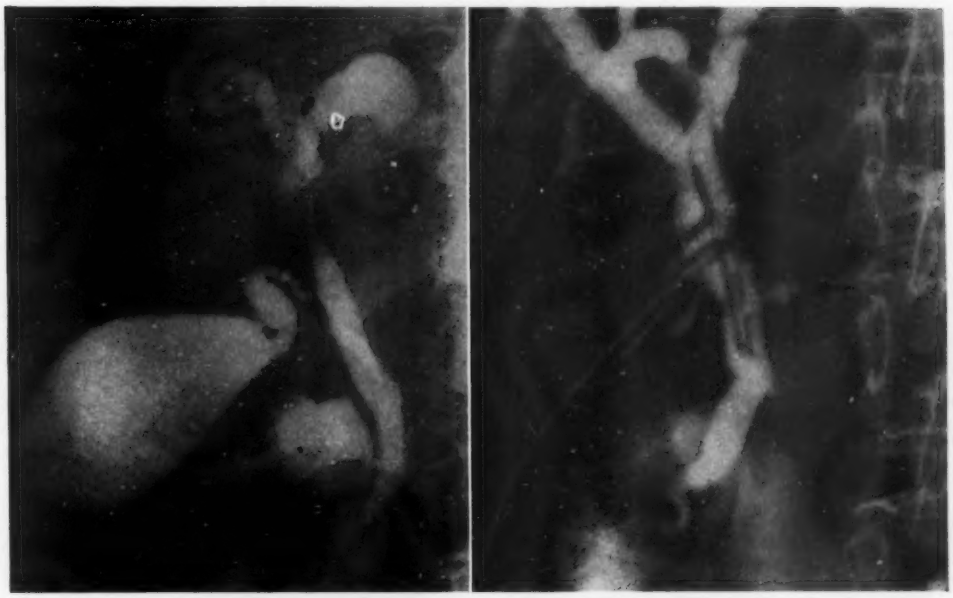

11A 11B

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TRANSVERSE OBLIQUE MUSCLE-SPLITTING INCISION FOR CHOLECYSTECTOMY

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Minneapolis, Minnesota

A TRANSVERSE oblique subcostal muscle-splitting incision can be used in cholecystectomy. Less than 20 per cent of gallbladder operations through this incision require additional exposure. This can be obtained by cutting across the rectus muscle.

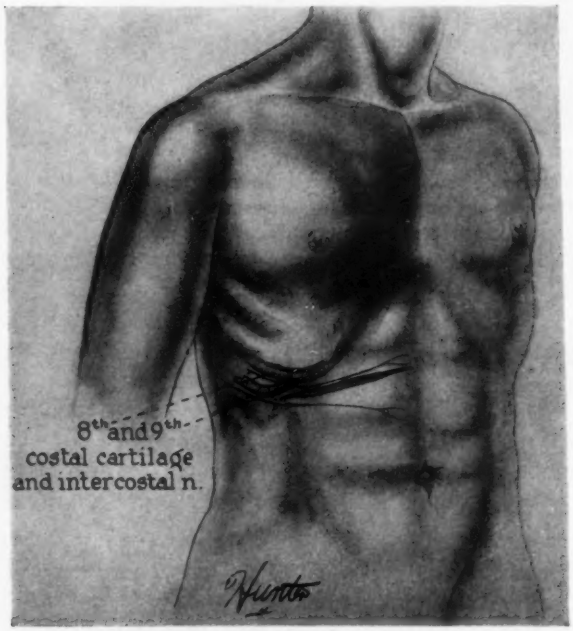


FIG. 1. Illustrates essentially the position of the transverse oblique subcostal incision. The prominence of the eighth and ninth costal cartilage is illustrated with the corresponding intercostal nerves. The incision is designed to pass between these two nerves. If the incision is properly placed, one or the other of these nerves is only rarely damaged. In contradistinction to this a right rectus incision for gallbladder exposure denervates the rectus muscle of the sixth to ninth nerves medial to the incision.

Although a greater knowledge of anatomy may be needed when using this incision, it is no more time-consuming than the conventional paramedian incision. Although the incidence of complications and sequellae was less in the group in which the transverse oblique muscle-splitting incision was used, the authors do not maintain that the incision was wholly responsible for these. No postoperative complications or sequellae attributable to this type of incision were encountered in the postoperative course of these patients.

* * * *

With the advent of early ambulation anatomic incisions for abdominal surgery

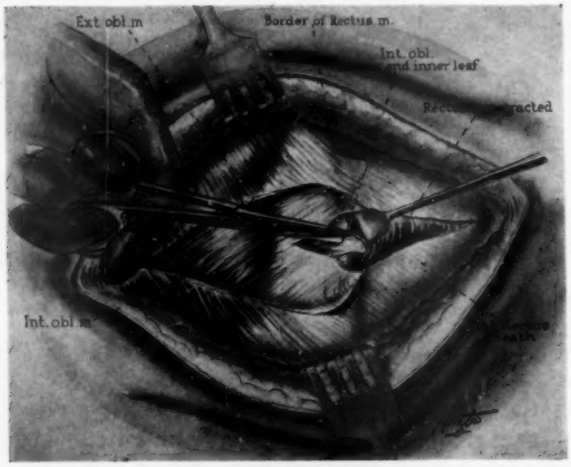
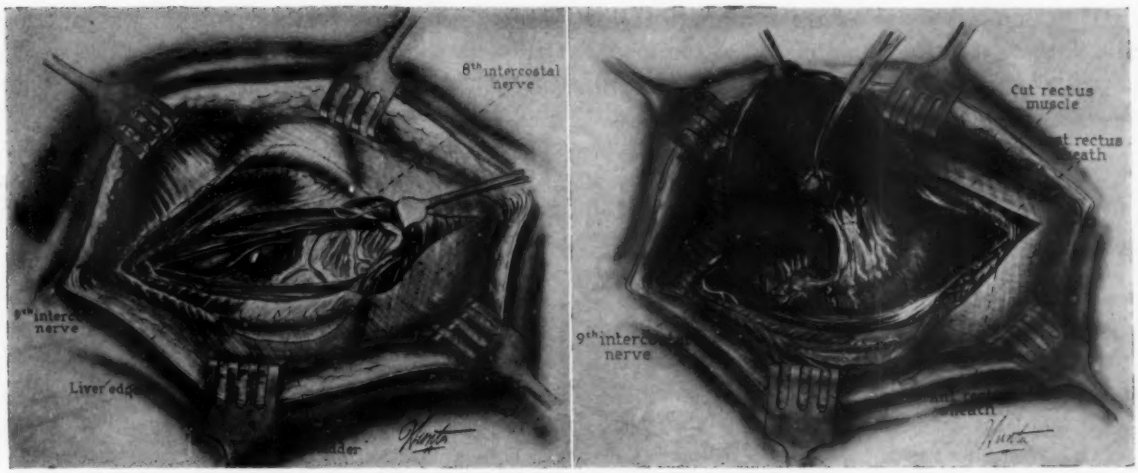


FIG. 2. For the sake of illustration the muscles have been exposed in this sketch considerably more than is encountered at the operation. Also, the inner and outer leaf of the internal oblique aponeurosis contributing to the anterior and posterior rectus sheath is a bit overdrawn. The shearers is shown entering the peritoneal cavity through the posterior rectus sheath under the retracted rectus muscle.

should become of increasing importance. In speaking of anatomic incisions it is inferred that muscle and aponeurotic planes and nerve supplies be preserved as much as possible. The value of cutting or spreading aponeurotic layers and muscle fibers essentially in the direction of their fibers and the importance of retaining nerve supplies to these structures would seem to be evident without rebuttal.

If adequate exposure can be obtained through anatomic incisions or if anatomic incisions can be extended so as to obtain additional exposure when needed, other objections to their use would seem to be insignificant or prejudicial.

For a number of years we have used a transverse oblique subcostal muscle-splitting incision for cholecystectomy. The incision



3 4

FIG. 3. For better illustration the cut exposure, the muscle planes and their separate identities are a bit overdrawn. The positions of the eighth and ninth intercostal nerves are illustrated. With a small amount of dissection in these areas these nerves can be quite readily identified at these positions. The fundus of the gallbladder is invariably found in the center of the retracting opening. The direction of the muscle fibers, each passing in a different tangential plane when retracted is released as in this operation, have a tendency to close over one another in a shutter-like action thereby protecting the abdominal wall against postoperative separation.

FIG. 4. This illustrates the exposure of the gallbladder and biliary ducts. This amount of exposure is obtained without difficulty and without cutting the rectus muscle unless the patient is excessively obese. This figure illustrates the cutting of the rectus muscle in this instance only partially. Unlimited exposure can be obtained in this manner.

which we use is very much similar to that described by Singleton and Blocker[1] except that our incision through the external oblique muscle and the anterior rectus sheath is somewhat more transverse than their drawings would indicate.

TECHNIC

The palpating fingers of the left hand are placed over the prominence of the ninth costal cartilage in order that the incision can thereby be directed between the eighth and ninth intercostal nerves.

The incision is made almost transversely beginning near the right border of the linea alba and extending laterally where it meets the lower border of the costal margin between the exit of the eighth and ninth intercostal nerves. (Fig. 1.) It is important that the proper position be identified in order that the incision will lie between the eighth and ninth intercostal nerves without cutting significant innervating branches. (Figs. 1 and 3.)

After the skin and subcutaneous tissue have been cut and retracted, the incision is made through the anterior rectus sheath, being careful not to cut the fibers of the rectus muscle. (Fig. 2.) This cut through the anterior rectus sheath usually lies about 1 cm. above the second tendinous inscription. The external oblique aponeurosis is at the same time split laterally to its muscle bundles which are usually encountered at the costal margin. Figure 2 illustrating the cut muscle bundles of the external oblique is overdrawn for the sake of clearer identification.

The rectus muscle is then separated from its sheath at its lateral margin in order that the muscles can be retracted medially. After retracting the rectus muscle medially the underlying posterior rectus sheath is picked up and cut through into the peritoneal cavity. (Fig. 2.)

The posterior rectus sheath is then cut medially under the retracted rectus muscle. The posterior rectus sheath is composed of the internal oblique and transversus abdominis aponeurosis. Often the transversus abdominis muscle fibers extend medially under the rectus muscle for a short distance before becoming aponeurotic. The peritoneum is at this point intimately adherent to the transversus abdominis muscle and cannot be opened separately. This must be remembered lest this identity be unrecognized and cause confusion in entering the peritoneal cavity.

After the peritoneal cavity has been entered, as in Figure 2, the internal oblique and trans-

versus abdominis muscles are split and pulled apart laterally, essentially in the direction of their fibers. This eliminates the danger of cutting the ninth intercostal nerve as might occur by cutting laterally with a shearers. (Fig. 3.)

As these muscles are spread apart, the ninth intercostal nerve can frequently be observed at the lateral apex of the incision. Not infrequently the eighth intercostal nerve will be visible in the upper flap of this opening as it enters the rectus muscle near its lateral border. (Fig. 3.)

The opening into the peritoneal cavity lies directly over the fundus of the gallbladder. In some instances the liver margin, extending below the costal margin, presents itself.

If for any reason it is desirable to extend the incision, the rectus muscle can be cut across throughout part or all of its width. (Fig. 4.) The wound is then held open with retractors and the gallbladder is removed in the usual manner. In all cases the wound is closed in layers with a combination of continuous and interrupted stitches.

RESULTS

An analysis has been made of all the gallbladder operations in the St. Barnabas Hospital in the past three years. Table 1 indicates the result of this analysis in which a comparison is made of two groups of cases. These comparative figures are presented merely to indicate that the transverse oblique muscle-splitting incision can be used to advantage in cholecystectomy. Group 1 illustrates a comparative resume of the cases operated upon by one of us in which in 96 per cent of the cases a transverse oblique muscle-splitting incision was used in contradistinction to the second group of patients operated upon by other staff members who made the approach through a paramedian incision in 92.5 per cent. An analysis of some of these figures indicates that the average postoperative hospital convalescence was eight days in the group in which the transverse muscle-splitting incision was used as compared to ten days in the group in which the paramedian incision was used.

The average operating time of forty minutes, despite the fact that other operative procedures were done in 35 per cent of the cases in Group 1 as compared to 20 per cent in Group 11, would suggest that the approach through a transverse oblique muscle-splitting incision was not more difficult than through the paramedian incision in which the average operating time was eighty minutes. The age of the patient and the history of jaundice, being essentially similar in both groups, would suggest that no significant differential selection was used in either group. The similar instance of common bile duct exploration (7.+ per cent) in each group indicates that a comparable degree of caution or curiosity was being observed in each group of patients.

TABLE 1
COMPARATIVE ANALYSIS OF CHOLECYSTECTOMY

	Group 1		Group 11	
	No.	%	No.	%
Total number of cases	51	....	163	....
Average age (yr.)	47.5	....	50.1	....
Postoperative hospital da	8.04	....	10.3	....
Average operating time (min.)	40	....	80	....
Jaundice	10	19.0	31	19.0
Type of incision:				
(1) Transverse oblique muscle-splitting	49	96.0	1	.6
Rectus muscle cut	8	16.0	0	0
(2) Paramedian	2	4.0	150	92.5
(3) Subcostal muscles cut	0	0	12	7.4
Drainage of gallbladder fossa	9	17.7	158	96.9
No drainage	42	82.3	5	3.1
Additional surgery:				
Appendectomy	16	31.4	25	15.3
Other	3	4.0	9	5.5
Common duct exploration and drainage:				
Rectus muscle cut	4	7.8	12	7.4
Postoperative sequellae and complications:				
Shock	0	0	23	14.1
Pulmonary (atelectasis, infarct, pneumonia)	1	2.0	10	6.1
Catheterizations	7	13.7	60	36.9
Prolonged fever	0	0	3	1.8
Nausea and vomiting	22	43.1	79	48.4
Gas pains (nurse interpreted)	7	13.7	20	12.3
Nasal suction needed	7	13.7	18	11.0
Thrombophlebitis	1	2.0	5	3.1
Wound separation	0	0	3	1.8
Evisceration	0	0	1	.6
Heart failure	0	0	1	.6
Mortality	1	....	0	....

The postoperative sequellae and complications although less frequent in some respects in Group 1 would seem to have no definite rela-

tionship to the type of incision. Other factors could have contributed to this difference.

COMMENTS

This incision has the advantage of being anatomic in nature in that muscle fibers and aponeuroses are not cut across but are cut or spread essentially in the direction of their fibers. Nerve supplies are not damaged and it is rarely necessary to cut either the eighth or ninth intercostal nerves.

The release of retraction allows the overlapping planes of muscles and aponeurosis to close over one another in a shutter-like action. This leaves the abdominal wall well splinted against internal pressure incident to postoperative coughing and retching.

Closure of the wound need not rely wholly upon suture materials. These serve as approximation stitches rather than retention sutures. As the abdominal muscles become tense, the opening closes tightly. (This has been demonstrated at operation by stimulating the patient to cough or strain.) The incision can be extended for more adequate exposure by cutting medially across the rectus muscle without sacrificing nerve supply. Healing of the rectus muscle after it has been cut transversely merely produces fibrous scar tissue very much similar to an additional transverse inscription.

Early ambulation is facilitated with this incision. The disadvantage of this incision is that wide exposure is not obtained through the primary incision but can be obtained by extending it across the rectus muscle. (Fig. 4.)

A more detailed knowledge of anatomy is needed to carry out this incision as one must be aware of the position of the adjacent nerves.

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Case Reports

VON RECKLINGHAUSEN'S DISEASE OF THE SMALL INTESTINE ASSOCIATED WITH SKIN LESIONS

R. CUNLIFFE SHAW, M.SC. F.R.C.S.

Preston, Lancashire, England

SOLITARY benign tumors of the small intestine are a comparatively rare pathologic entity, but multiple growths of this type have seldom been encountered. The case herein recorded in which there were approximately 100 neurofibromas arising from several feet of the ileum would appear to be of unique interest, particularly in view of the association of the neurofibromas with typical neurofibromatosis of the integument. Neurofibromatosis of the small intestine is very uncommon. Chalkley and Bruce[4] reported that they had found nine cases but were satisfied that there were probably more in the literature. They recorded a case of neurofibromatosis in a Negro girl aged eight years. The tumors occurred in the mesentery of the terminal ileum near the bowel attachment with a specially large mass at the ileocecal junction, and similar growths were present in the mesentery of the colon and the cecum. In the latter instance the tumor mass projected into the lumen of the bowel near the base of the appendix. The intestinal wall was enormously thickened and histologic examination showed neurofibromatosis. In this instance there were no neurofibromas present in the skin.

Neurofibromatosis of the mesentery has also been reported[1,2,6,13,17] and in these cases the tumors commonly arose in the region of the appendix and cecum. A most interesting case was reported[7] of a fifty year old man who also had von Recklinghausen's disease of the skin. In this case multiple growths the size of a nut had caused intussusception of the cecum into the transverse colon. Histology proved the growths to be neurofibromas. Weber has described a case of neurofibromatosis in this region.

An analysis in 1927 of all the recorded cases of benign tumors of the small intestine made by Clifton and Landry showed that there were only twenty-nine cases reported up to that date. These included fibromas, myxofibromas, myxomas, fibrolipomas and one case of adenofibroma. In 1932 Cave reported a case of fibroma of the ileum and Larson described a submucous myxofibroma of the ileum. In 1933 Rankin and Newell reported four fibromas in the records of the Mayo Clinic, but only one of these was a pure fibroma, the others having undergone myxomatous change or had become hyalinized or calcified so that it was impossible to determine whether the histogenesis was that of a fibroma or a myoma.

Moore and Schmeisser[12] again reviewed the cases reported in the literature and included one of their own. They found that in the forty-two patients on record with benign tumors of the small intestine the distribution of the tumors was as follows: duodenum three, jejunum six, ileum twenty-three, small intestine but not particularized, ten. In thirty-three cases the tumor was intraluminal in type, in eight cases it was extraluminal and in one case the relation of the tumor to the bowel was not stated. Of these series only three cases exhibited multiple tumors and in each of them not more than three or four tumors were present.

Gottesman and Peria[8] reported a case of multiple fibromatous polyposis of the intestine. The man, a middle-aged Russian, had bilateral apical pulmonary tuberculosis and had had recurrent attacks of diarrhea, tenesmus and abdominal pain. Autopsy revealed multiple fibromatous polyps of the large intestine, associated with tuberculous ulcers of the terminal ileum.

The following case is presented because of the rarity of the lesion and the extraordinary multiplicity of the tumors and their association

with the typical von Recklinghausen's condition of the skin. Moreover, the clinical aspects of the case are of additional interest.

CASE REPORT

A man aged forty-seven, a rubber worker by occupation, was admitted to my surgical unit at the Preston Royal Infirmary on November 30, 1948, as an emergency patient suffering from severe rectal hemorrhage. He stated that while lifting a heavy weight he experienced a sensation of strain in the lower abdomen and shortly after this he went to the lavatory and passed a large quantity of dark red blood. Before admission to the hospital he had had another melena stool. The patient gave no history of pain apart from that of the occupational strain and had suffered from no symptoms of indigestion. The only significant clinical feature prior to the rectal hemorrhage was a history of recurrent attacks of diarrhea extending over a period of fifteen years. Each of these attacks lasted between two and four days. They were never accompanied with bleeding from the bowel and in the latter years he had gained rather than lost weight.

On admission the patient appeared pale. His abdomen was moderately distended and of a doughy consistency, but no tumor mass could be distinguished on palpation. Over the lower abdomen was a deep tenderness on pressure and slight muscle guarding of both lower recti. There was no tenderness over the upper abdomen. Digital examination of the rectum showed that this was ballooned and contained a large quantity of dark red blood mixed with feces, but no other abnormality could be distinguished. His blood pressure was 180/118; hemoglobin, 78 per cent; blood urea, 45 mg. per 100. His temperature was 98°F., pulse 98, respirations 20. No pathogens were isolated on culture of the feces. The surface of his body presented multiple lesions of the typical von Recklinghausen's type and he gave a history of having one of these tumors excised nearly thirty years previously. At the time of examination about six or seven neurofibromas varying from the size of a small egg-like mass to the size of a nut were present, irregularly distributed on the trunk and limbs.

Following sedative therapy the patient's condition improved and there was no recurrence of the rectal hemorrhage. On December 3rd sigmoidoscopy was carried out and no pathologic abnormalities were seen except a minute polyp at a distance of 10 cm. from the anus, and the lower bowel was free from blood. After the initial recovery the patient began to suffer from vague discomfort in the lower abdomen which continued to be slightly distended and tender on pressure especially below and to the left of the umbilicus. Barium enema and x-ray examination of the colon on December 8th revealed no obstruction to the flow of the enema, but the pelvic colon showed some evidence of spasm and a slight notching suggestive of prediverticulosis.

Despite the non-recurrence of rectal bleeding, the persistent distention and tenderness pointed to a definite lesion and laparotomy was carried out on December 16th. On opening the abdomen the most remarkable pathologic condition was apparent. Over 5 feet of the ileum was literally festooned with clustered masses of solid tumors varying in size from a pinhead to small tomatoes and presenting many shades of color from pale white to dark purple and wine red. The tumors arose mainly from the antimesenteric border of the bowel and at least two of them appeared to be gangrenous while many others showed evidence of hemorrhage. In the center of the affected area of the intestine a growth was obviously constricting the lumen. The tumors commenced as minute projections on the intestinal wall about 7 to 8 feet from the ileocecal junction and rapidly increased in size covering the bowel for the next 5 feet and again rapidly diminished and faded to minute projections approximately 2½ feet from the termination of the ileum. There was no evidence of any enlargement of lymphatic glands or tumors in the mesentery, and the remainder of the small intestine, large bowel and other abdominal viscera showed no pathologic abnormalities. Over 5 feet of the ileum were resected and a side-to-side anastomosis was performed.

During the operation and on subsequent days 3 pints of blood were given followed by 2 L. of one-fifth normal saline and 8 L. 5 per cent glucose saline.

The patient's recovery was slow and on December 25th he passed a considerable melena stool. His pulse rose to 116, but there was no abdominal distention, pain or tenderness and hemorrhage did not recur following morphine therapy. On December 28th he complained of pain in the chest. There was moderate pyrexia, 99 to 100°F., and pulse

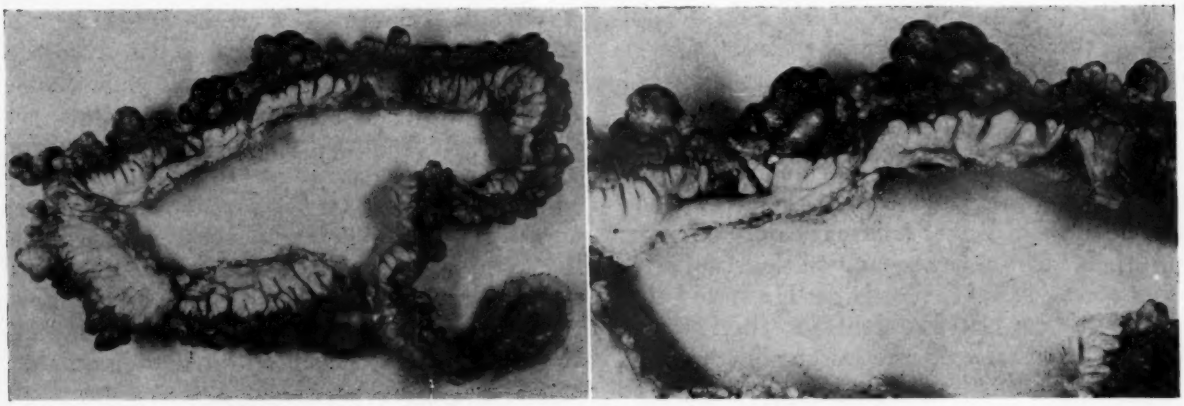

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FIG. 1. One hundred twenty cm. of resected ileum showing the general distribution of the neurofibromas.
FIG. 2. A portion of the resected ileum showing the details of the relationship between the tumors and the bowel.

elevation, 100 to 110. A skiagram of the chest showed elevation of the right diaphragm and evidence of a former resection of the seventh right rib. The lung fields were clear. These symptoms subsided following intensive penicillin therapy and after the disappearance of the pyrexia profuse diarrhea commenced and a film of the feces showed pus cells, red blood corpuscles and mucus, but no pathogens were isolated. The benzidine test was strongly positive (one in ten approximately).

A course of sulfathaladine was given from January 4th to the 15th which was followed by a steady improvement in the patient's general condition as the bowel frequency subsided. A further barium enema and x-ray examination of the colon was negative. The patient's hemoglobin rose to 90 per cent and the blood urea fell to 20 mg. He was discharged on January 19, 1949, since which time he has remained perfectly well.

The pathologic examination of the resected bowel showed that it consisted of 120 cm. of the ileum. Along the antimesenteric border of this bowel there were approximately 100 round and oval firm tumors varying in size from ½ to 3 cm. in diameter. They were distributed fairly regularly, many were pedunculated, some sessile and others in clusters. There were numerous seedling tumors on the peritoneal surface between the antimesenteric border and the mesenteric attachment, and one or two were lying in the mesenteric fat. (Figs. 1 and 2.)

On opening the gut the mucosa was found intact and there were a few submucous round tumors bulging into the lumen. At these points, as well as in places in which clusters of tumors were found, there was narrowing of the lumen which barely admitted the blades of a pair of scissors.

A proportion of the tumors were cross-sectioned, they were all encapsulated, pale pink in color and showed the macroscopic features of fibromas. There were hemorrhages into a few of these. (Figs. 3 and 4.)

Histologic examination showed that all the growths were multiple benign neurofibromas. The tumors consisted of bundles of well developed cellular collagenous fibrous tissue interlaced and whorled. There were areas of marked vascularity and large hemorrhages and in some of the tumors hyaline degeneration was a prominent feature. The mucosa of the bowel was intact.

Subsequent to his recovery two of the skin tumors were excised and these showed the typical histologic features of neurofibromas with fibrous and nervous elements in varying proportions in different parts of the tumors. The fibrous tissue was highly cellular, arranged in a whorled, interlaced and irregular manner and containing numerous proliferating nerve fibrils.

SUMMARY AND CONCLUSION

A brief review of the literature concerning benign tumors of the small intestine has been given. This reveals the great rarity of multiple neurofibromas of the ileum and in nearly all the cases recorded in which multiple tumors were present, only a few of these growths occurred. In the case reported herein the extraordinarily large number of neurofibromas arising from the bowel wall and not the mesentery is of unique interest, but an additional feature of outstand-

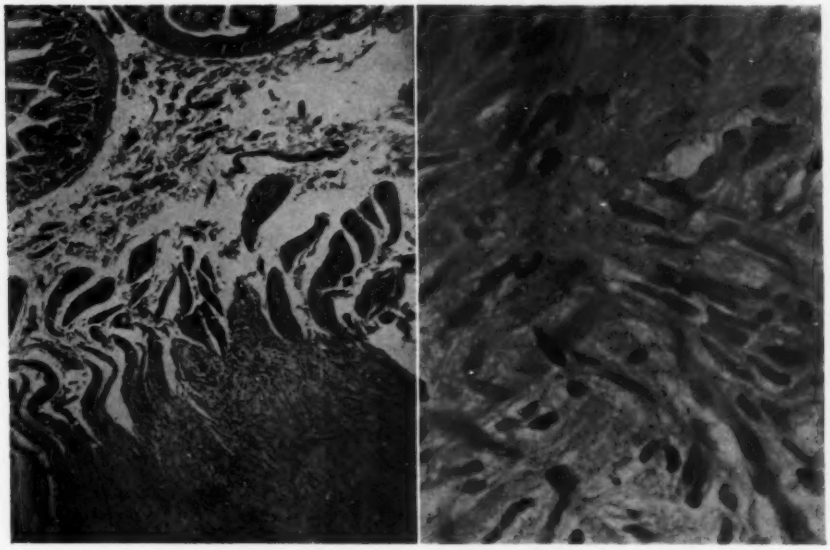

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FIG. 3. Section of neurofibroma of the ileum showing relationship of the tumor to the mucous and submucous layers; × 50.
FIG. 4. Neurofibroma from the ileum; × 650.

ing importance is the association of the intestinal lesion with the typical von Recklinghausen's neurofibromatosis of the skin, the history of which extended over thirty years. Without doubt the lesions are closely associated and it is of interest to note that in the few other cases recorded of intestinal neurofibromatosis the tumors nearly always arose in the region of the terminal ileum, cecum and ascending colon and their associated mesenteries.

The clinical history of the case is outlined together with the operative and pathologic findings. From a clinical standpoint the outstanding intestinal feature prior to the sudden hemorrhage was a long history of recurrent attacks of diarrhea which agrees with those cases previously reported.

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SEGMENTAL RESECTION OF THE LUNG FOR ASPERGILLOSIS*

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PULMONARY segmental resection and lobectomy have become fairly common procedures in the treatment of localized conditions of the lung. It has been employed chiefly in cases of chronic pulmonary disease in which other modalities have failed to yield satisfactory results. In the case presented herein we were disposed to perform a segmental resection because of the localized chronic pulmonary disease which failed to respond to other therapeutic measures and because of the recurrent and uncontrollable hemoptyses. After removal of the diseased lung tissue much to our astonishment the cause of the patient's infirmity was found to be the result of an "aspergillus infestation."

The Aspergillus was first described by Micheli in 1725.[6] Hugh Bennett (1842) is reputed to have been the first to report a case of pulmonary aspergillosis.[6,20] A few years later Rudolf Virchow (1856) performed the first autopsy on a patient having aspergillosis of the lung. On the basis of their observations in several cases Dieulafoy, Chautemesse and Widal[5] in 1890 described the clinical aspects of this disease. Their cases occurred among persons employed to fatten pigeons for the Paris markets. In the course of their chores these attendants would hold contaminated feed in their mouths and force it into the mouths of the pigeons.

Pulmonary aspergillosis is a rare disease although Aspergilli are widespread in nature and are abundant in soil. It has been postulated by many writers that massive and repeated doses of the organism are necessary before pulmonary aspergillosis is produced.[2,4,11,13,15–17,20] Even under these conditions the disease does not occur unless local or constitutional resistance is lowered for a long time. This has prompted some investigators to speak of the infestation as a "secondary" disease. Constitutional disturbances which lower the general resistance of the patient such as carcinomatosis, dysentery, enteritis and uncontrolled diabetes mellitus have been found to predispose to pulmonary aspergillosis.[1,8,10,12,19] Pulmonary tuberculosis, primary cancer of the lung, bronchial asthma and other chronic pulmonary infections are local lesions which on rare occasions were complicated by aspergillosis.

CASE REPORT

F. B. (Hospital No. 38574), a forty-eight year old white male, was admitted to Kings County Hospital on August 24, 1946. He dated the onset of his illness to February, 1945, when he inhaled some soap powder while at work. Immediately after this episode he had a severe spasm of cough lasting for about half an hour. For the following ten days he had a productive cough and expectoration of a large amount of mucoid sputum. About two weeks after the onset of his illness he noticed some streaks of blood in his sputum. On March 15, 1945, he had severe hemoptysis, coughing up about 1 pint of blood. An x-ray of the chest taken sometime thereafter was interpreted as indicative of active pulmonary tuberculosis of the left lung. Accordingly, he was admitted to a hospital on July 6, 1945. Here numerous studies of sputum failed to show the presence of tubercle bacilli. Several cultures of sputum were also negative for fungi. After a year's stay at this hospital he was discharged unimproved and without a definitive diagnosis. He continued to have recurrent hemoptyses of varying severity. He did not return to work because he feared exertion would provoke further bleeding.

Two days prior to readmission to Kings County Hospital the patient had sudden and profuse bleeding from the lung so that within eight hours he lost 2 to 3 pints of blood. In addition to the aforementioned the patient gave a history of having diabetes mellitus for about twelve years which was controlled by daily doses of ten units of protamin-zinc insulin and ten units of regular insulin. At the time of the patient's admission to Kings County Hospi-

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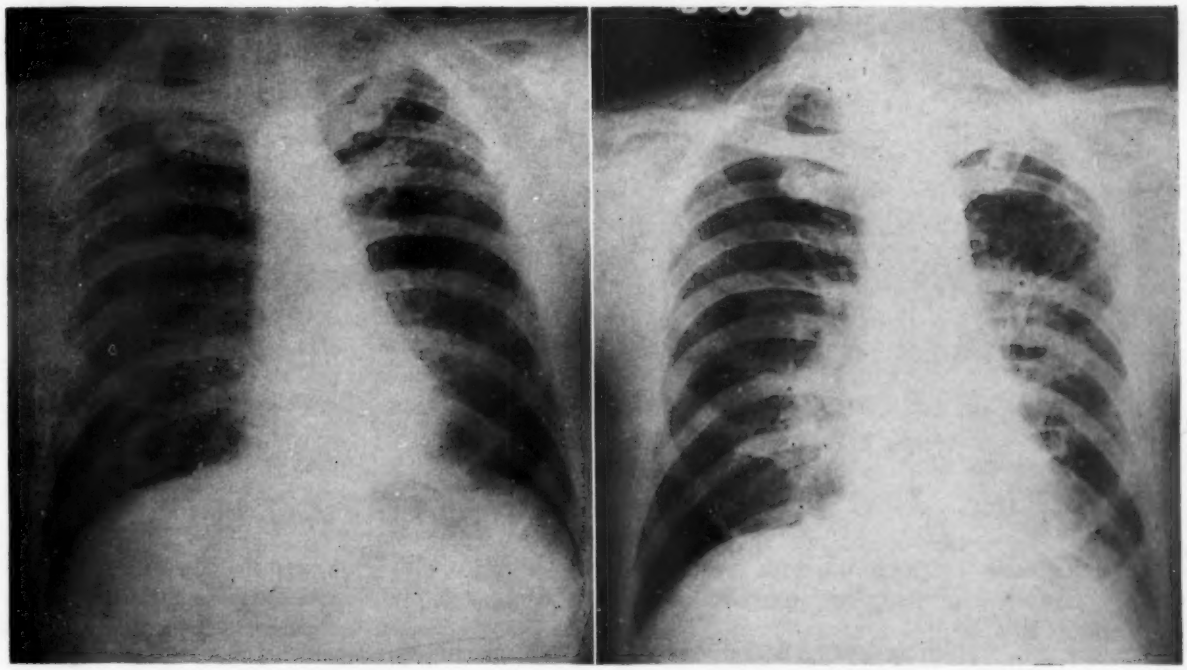

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FIG. 1. Roentgenogram of the chest taken shortly after admission to the hospital.
FIG. 2. Roentgenogram of the chest taken about ten months after operation.

tal the only positive physical findings were fine, moist rales at the end of inspiration in the apex of the left lung both anteriorly and posteriorly. An x-ray of the chest taken shortly after admission revealed an area of infiltration in the left clavicular region toward the periphery of which there was a small cavity. The lesion was highly suspicious of tuberculosis. (Fig. 1.) The Wassermann test was negative. The fasting blood sugar was 168 mg. per cent. Bronchoscopy revealed slight reddening of the left main bronchus. Many casual and concentrated sputa were negative for tubercle bacilli. Several sputa were negative for fungi.

While at the hospital the patient continued to have moderately severe hemoptyses necessitating repeated blood transfusions. When active bleeding diminished and the sputum was only blood streaked, the patient was considered for surgical therapy. It was the opinion of the surgical staff that in view of the localized pathologic condition in the upper lobe of the left lung and the persistence of hemoptyses for over twenty months the patient would be benefited by resection of the diseased lung tissue. Accordingly, on November 14, 1946, under general endotracheal anesthesia an exploratory thoracotomy was performed. Many dorsal and apical adhesions were found which were readily divided. The anterior segment of the upper lobe was dark red, indurated and much firmer than the surrounding lung tissue. The segment was resected after isolating the branch bronchus and vessels to this part of the lung tissue.

The postoperative course was uneventful, the patient's temperature rising to 101.4°F. on the first and second postoperative days and returning to normal on the seventh postoperative day. The patient was out of bed on the third postoperative day. Penicillin was given intramuscularly until the ninth day after surgical intervention. During the postoperative period the diabetes mellitus was readily controlled by diet and insulin. The patient was discharged to the Thoracic Surgical Clinic on December 24, 1946, and was seen periodically in the clinic for a year. There has been no pulmonary bleeding since the day of surgical intervention. Repeated examination and culture of the sputa have been negative for Aspergilli. Several follow-up roentgenographic examination of the chest have failed to reveal any pulmonary infiltration. (Fig. 2.) His general health has remained good and he has returned to work without any deleterious effects.

The pathologic report on the tissue removed at the time of operation revealed the following: The microscopic examination showed markedly

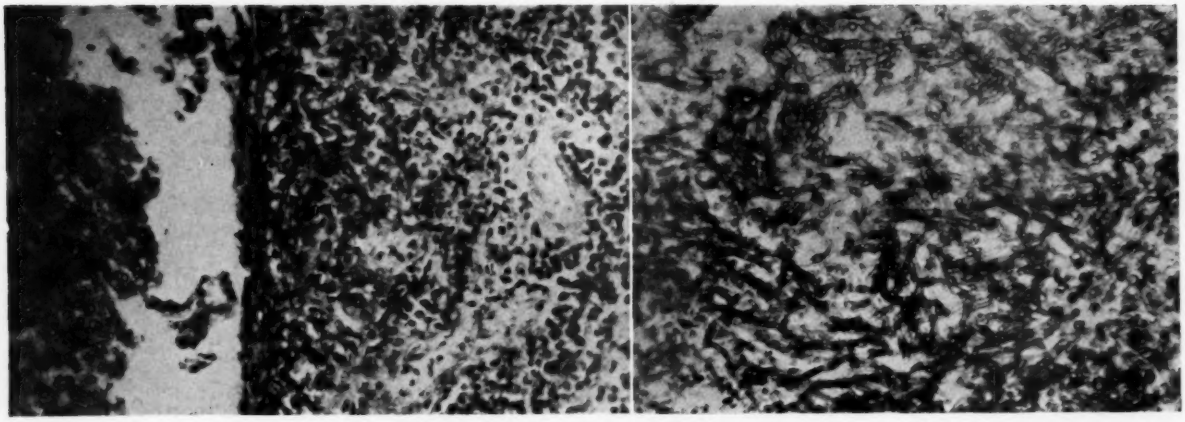

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FIG. 3. Photomicrograph of the pulmonary process showing the Aspergillus infestation and surrounding secondary inflammatory changes; magnification 150 ×.
FIG. 4. Photomicrograph of the pulmonary field showing the Aspergillus infestation; magnification 360 ×.

thickened pleura composed of dense, hyalinized, fibrous tissue. The bronchi and bronchioles were widely dilated; the mucosa showed patchy areas of necrosis. Within the lumen of one bronchus there was a large matted collection of septate mycelia among which were numerous polymorphonuclear leukocytes. Many conidiophores were present, each consisting of an unbranched, non-septate hypha with a terminal swollen tip or vesicle at the summit, of which conidia were noted. The bronchial walls showed edema, interstitial hemorrhage, fibroblastic proliferation and a dense, diffuse infiltrate of lymphocytes, plasma cells and polymorphonuclear leukocytes. (Fig. 3.) The diagnosis was pulmonary aspergillosis. (Fig. 4.)

COMMENT

Graham, Singer and Ballon[9] state that up to 1935 there had been no case reported in the literature in which pulmonary resection had been undertaken for aspergillosis. They add that "the application of surgical methods may be found to be valuable." A review of the literature since 1935 fails to reveal any cases in which lung tissue was removed for aspergillosis.

The onset of pulmonary aspergillosis is very insidious. There are no distinctive clinical features or signs. The disease simulates a variety of pulmonary lesions so that its clinical identity is even more difficult. It is most often confused with pulmonary tuberculosis both clinically and on roentgenograms. In all patients whose x-rays reveal changes suggestive of pulmonary tuberculosis and whose sputa are repeatedly negative for tubercle bacilli, fungus infection of the lung must be considered. Bronchoscopic aspirations of the bronchus leading to the pathologic area should be studied for organisms. It is also significant that patients with pulmonary aspergillosis are generally in better physical condition than those with pulmonary tuberculosis despite repeated hemoptyses.

The lesions occurring in pulmonary aspergillosis are divided into the superficial form and the deep or ulcerative form. The superficial form is benign and clinically simulates an upper respiratory infection or bronchitis. The symptoms consist of a low grade fever, paroxysms of cough and the production of small amounts of tenacious mucoid sputum. In the more acute stage it may simulate pneumonia. The deep or ulcerative form presents many of the characteristics of pulmonary tuberculosis, often appearing as an exudative, caseous pneumonia or chronic productive tuberculosis. Because it mimics tuberculosis, it is often referred to as "pseudotuberculosis"[17] and accounts for the large number of these patients being "discovered" in tuberculosis sanitoriums.[10,11,13,15,17]

SUMMARY AND CONCLUSIONS

A case is presented in which segmental resection of the lung was performed for pulmonary aspergillosis. One year after the patient was operated upon there was no recurrence of pulmonary bleeding nor roentgenographic evidence of pulmonary disease.

Primary pulmonary aspergillosis is a rare disease. It can be diagnosed only after thorough investigation.

Secondary pulmonary aspergillosis is common. Here the treatment should be directed toward the primary disease.

Resection of the pulmonary tissue is valid treatment in cases of localized pulmonary aspergillosis.

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INTUSSUSCEPTION DUE TO INVERTED MECKEL'S DIVERTICULUM*

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INTUSSUSCEPTION due to an inverted Meckel's diverticulum is not a common occurrence. Harkins, in 1933 reviewed the literature and analyzed the 160 cases on record at that time. It is generally agreed that the inverted diverticulum acts in a manner similar to that of a polyp or other body inside the bowel, being caught by the peristaltic movement and carried lower in the gastrointestinal tract. This creates an intussusception, the diverticulum or tumor serving as the leading part. All the accounts in the literature are those of spontaneously inverted diverticula. We wish to report a case in which Meckel's diverticulum had been inverted surgically during the course of a previous operation.

FIG. 1. Roentgenogram showing distended loops of small bowel, indicating obstruction.

CASE REPORT

Mrs. F. G. L., a thirty-three year old white female, was admitted to the Baptist Memorial Hospital on January 15, 1947, with the following history: In October, 1946, she had a pelvic operation at which time "the tubes were removed and a tumor of the intestine was infolded." She seemed to get along well until one week prior to her admission to the Baptist Memorial Hospital when she was seized with abdominal cramps. Three days later she began having abdominal pain and distention with nausea and vomiting, the vomitus having a fecal odor. She had been given an enema before admission but with practically no results.

On examination the patient was acutely but not critically ill. Her temperature was 100°F. The abdomen was soft but slightly distended and moderately tender throughout, and increased peristalsis was heard over the lower half. Roentgenograms revealed distention of the small bowel, pointing to an obstruction in or near the terminal ileum. (Fig. 1.) The obstruction was not quite complete, as evidenced by one small bubble of gas in the ascending colon near the hepatic flexure.

Operation was performed under spinal anesthesia, through the right rectus scar of the previous operation. Upon opening the abdomen all the visible loops of small bowel were found greatly distended from obstruction by an extensive intussusception at the ileocecal juncture. The intussusception formed quite a large mass in the cecum and ascending colon and was reduced with considerable difficulty. The intestine was viable, however, and the circulation appeared ample. Upon further examination a definite mass was discovered in the lumen of the ileum about 16 inches proximal to the ileocecal juncture. At this point there was a small scar on the serosal surface (Fig. 2). The

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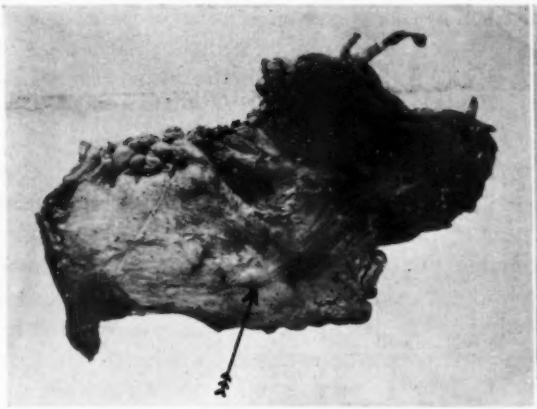

FIG. 2. Surgical specimen, showing scar on serosal surface where Meckel's diverticulum was inverted.

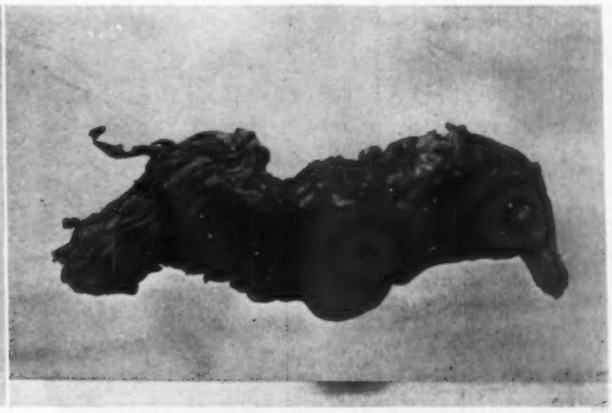

FIG. 3. Open surgical specimen showing Meckel's diverticulum which produced obstruction following inversion into the lumen of the intestine.

mass felt about the size of the end of a man's thumb and was almost completely occluding the lumen. Apparently this was a Meckel's diverticulum which had been inverted at the previous operation, and having been caught in the peristaltic movement, was responsible for the intussusception. Because of the occlusion and fearing another intussusception from this source, the diverticulum, with about 6 inches of the ileum, was resected. Both ends of the intestine were closed and a lateral anastomosis was made in the usual manner. Five grams of sulfanilamide were placed in the abdominal cavity and in the incision, and the abdomen was closed without drainage.

The pathologic report revealed the following: Grossly, the specimen consisted of a section of small intestine measuring 12 cm. in length and 3 cm. in diameter. At a distance of 6 cm. from one end of the section a hard mass was felt in the lumen or projecting into the lumen from the intestinal wall. Above this on the serosal surface there was a definite scarring which measured 2.5 cm. in length and was transverse to the long axis of the intestine. There were fibrous adhesions about this portion. The serosal surface of the remaining portions of the intestine was hemorrhagic and dark. On inserting the small finger the mass within the lumen could be passed. On opening the specimen the mucosal surface was 6 cm. from the severed end, was hemorrhagic and dark in color. At this point there was a polymoid mass which measured 2.5 cm. in length and 3 cm. in diameter and had a linear-shaped attachment measuring 2.75 cm. (Fig. 3.) The mass was dark in color and rather soft in consistency. The remaining mucosa was somewhat hemorrhagic but not as dark as the growth and the other portion of the mucosa.

Microscopic section of the inverted pouch of small intestine showed the lining partly hemorrhagic and partly that of the intestine. The layers consisted of mucosa, muscularis mucosa, muscularis and adventitia. It was entirely consistent with a diverticulum of the Meckel type which had been inverted surgically, the surgical inversion being evidenced by the presence of suture material imbedded in foreign body granulomas. The remainder of the resected loop showed severe congestion, edema and hemorrhage, particularly of the submucosa, and hemorrhagic necrosis of the crests of the villi. This reaction is consistent with early intestinal obstruction.

The diagnosis was as follows: (1) Meckel's diverticulum, small intestine, inverted surgically into the lumen and (2) intestinal obstruction by intussusception, secondary to the inverted diverticulum.

The patient's postoperative course proceeded without disturbance. Gastric suction was employed for three days and fluids were given parenterally. She was out of bed and walking on the seventh postoperative day. Upon discharge on the fourteenth postoperative day her bowel function was normal and she was free of all her former symptoms. When next observed four weeks later she had one or two bowel movements daily without the use of laxatives or enemas, had a good appetite, had gained several pounds in weight and was feeling entirely well. Palpation of the abdomen elicited no masses nor areas of tenderness.

COMMENTS

This case presents several points of interest. First, one might ask what should be done to a Meckel's diverticulum which is found incidentally during the course of an operation. If the base is broad, permitting complete emptying, and it appears healthy, the wise course would seem to be to leave it alone. On the other hand, if the base is narrow or constricted, excision followed with purse-string suture of the stump is indicated. Certainly, a Meckel's diverticulum should never be simply inverted. Diverticula in the stomach may be sutured with purse-string with safety, but not in the ileum where the lumen is small. There are many reports of heterotopic gastric and pancreatic mucosa in these diverticula, and bleeding is not uncommon. They are likewise subject to inflammation and perforation. For these reasons it might be best to remove those with a broad base, as well, the sutures being placed parallel with the long axis of the intestine. In the hands of the experienced surgeon this can be done quickly and safely.

One might also ask why the section of intestine was removed in this case. There was no choice. The segment was damaged and contained a pedunculated mass within its lumen. To leave it invited a recurrence of the intussusception. To perform an enteroenterostomy around it might overcome the obstruction but would leave a mass, the nature of which was suspected but not known. Under such circumstances, a resection of the diseased area seemed the only logical procedure.

REFERENCE

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PATIENTS with advanced pulmonary tuberculosis who also have anorectal tuberculous lesions requiring surgery will usually do better if they are simultaneously treated with adequate doses of streptomycin as well. In fact, this antibiotic prevents any extension of the pulmonary tuberculosis that otherwise might occur during surgery. It also hastens recovery from the anorectal operation, be they incisions or excisions. (*Richard A. Leonardo, M.D.*)

TARDY ULNAR PALSY*

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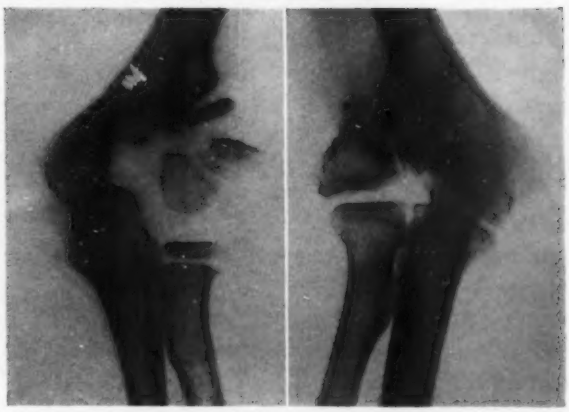
TARDY ulnar palsy is a typical although infrequent sequela to fractures of the lateral condyle of the humerus in childhood. In a large institution one may see such a case about once every two years. The history is invariably the same: An elbow fracture is sustained at an early age. Many years later, the average being twenty years, ulnar nerve symptoms occur, first sensory in character but soon followed with motor weakness within the distribution of this nerve.

The fracture of the lateral condyle if inadequately treated is apt to end in a rather loose, fibrous union; thereby the further growth of the lower end of the humerus is thrown off balance. Its medial portion continues to grow normally and in so doing gradually pushes the elbow into a valgus position. The deformity increases until growth is terminated. The younger the child is at the time of injury, the more marked the deformity will be. The angulation of the elbow joint puts the ulnar nerve under tension which necessarily increases with flexion movements. However, the forces at work seem to be exceedingly small as it takes about two decades before nerve symptoms become manifest. (Figs. 1 and 2.)

The object of treatment is to lessen the tension of the nerve. This has occasionally been accomplished by wedge osteotomy of the lower end of the humerus in order to correct the cubitus valgus. The method has been advocated in France. Yet the elbow deformity as such is hardly a factor which necessitates correction. Much simpler, therefore, and at least equally effective is the transference of the ulnar nerve to the flexor side of the elbow. This has become the standard procedure.

It is generally agreed and has also been our experience that this operation is apt to bring about recovery of the nerve. It should be emphasized, however, that the operation should be performed as soon as nerve symptoms are noticed. If the irritation of the nerve is allowed to continue, irreversible changes within the nerve may develop. This fact was made clear to us in the following case:



1 2

FIG. 1. The type of fracture having the earmarks of a potential late ulnar palsy. Non-union is present, as is a cubitus valgus, apt to increase with further growth.
FIG. 2. Typical picture of the elbow in the adult with late ulnar paralysis.

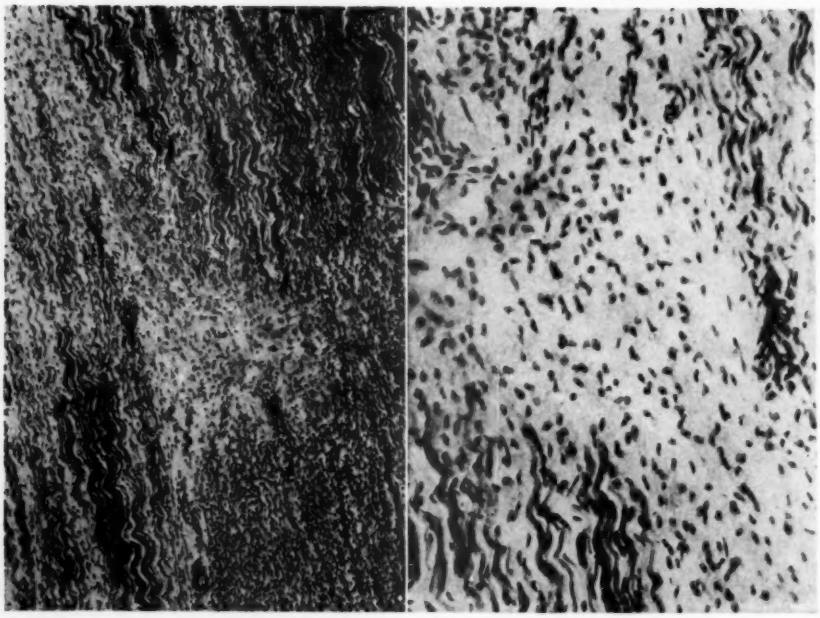
CASE REPORT

A thirty-five year old man whose elbow fracture dated back to the age of seven experienced the first ulnar symptoms twenty-six years after. For some reason two more years elapsed before he consented to surgery.

Upon exposure of the nerve a flattened, tense, band-like structure was found running behind the medial condyle about twice as wide and half as thick as the normal caliber of an ulnar nerve. This widened portion of the nerve extended about 3 cm. along the epicondylar groove, while above and below this part the nerve maintained its regular appearance.

The nerve was transferred to the flexor side in typical fashion. During the following three months the nerve failed to show even the slightest degree of recovery. With the gross changes encountered at the time of operation the failure of the nerve to respond was hardly surprising. Therefore, the nerve was again exposed and the flattened portion (3 cm.) resected. The nerve stumps were united end-to-

* From the Orthopedic Service of Bellevue Hospital, New York, N. Y.



3 4

FIG. 3. Longitudinal section through specimen of ulnar nerve.
FIG. 4. Center part in higher power.

end by perineural sutures. This could be done without undue tension as one gains sufficient length by its transference.

Histologically, the resected portion showed disruption and degeneration of the normal wavy nerve bundles with replacement by fibrous tissue, and an inflammatory exudate, consisting of round cells, plasma cells and fibroblasts. (Figs. 3 and 4.) Thus, besides changes of a chronic inflammatory nature which could be expected to recede under improved mechanical conditions, there were also irreversible degenerative changes.

On the whole the outcome of the resection was not too satisfactory. Although function returned in part, the result did not compare with those obtained by early performed transposition of the nerve.

CONCLUSION

In conclusion it may be said that preventive measures, namely, adequate fracture treatment by open reduction and internal fixation, would render the whole problem practically non-existent. Once tardy ulnar palsy has developed, immediate transference of the nerve is indicated.

RETROPERITONEAL LIPOMAS*

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RETROPERITONEAL lipomas are rare, but a sufficient number of cases have now been placed on record to permit the description of the special features of these tumors. It is necessary in the first place to distinguish these tumors from other retroperitoneal tumors, more particularly the mixed tumors of teratomatous origin, as the presence of some fat in a teratoma should not suffice to determine the inclusion of such a case among the retroperitoneal lipomas.

Pemberton and McCaughan (1933) reviewing the cases at the Mayo Clinic from 1910 to 1930 found only forty-two cases of retroperitoneal lipoma in 314 cases of retroperitoneal tumor. Lecéne (1919) found only ten cases of lipoma in a series of thirty-three cases. It is also necessary to exclude from consideration the cases of replacement lipomatosis in which renal atrophy is accompanied with fat substitution, a process described by Virchow and made the subject of study by Elansky (1929).

The true retroperitoneal lipoma is a neoplasm which reaches a size that would enable it to be clearly distinguished from a replacement lipomatosis. Indeed, in the largest recorded cases the tumor has reached from diaphragm to pelvis, a size not equalled by any other solid abdominal tumor.

These tumors usually originate in the neighborhood of the perinephric fat. Von Wahlendorf (1921) found that in 132 cases in which accurate records had been made of the site the tumor was in the abdomen in 104 cases (79 per cent) and in the pelvis in twenty-eight cases (21 per cent). Of the tumors which originate in the perinephric fat, some arise from the substance of the kidney while others have no connection with the kidney, a point of differentiation of some importance as the former have needed nephrectomy or partial nephrectomy for their extirpation. Pemberton and McCaughan (1933) found that there were two intrarenal lipomas to forty extrarenal tumors. Schmid (1923) found that nephrectomy was required in 138 operations (29.7 per cent). The origin of lipomas from the substance of the kidney is difficult to explain as the interstitial tissue of the kidney contains no fat. Whether the lipoma is derived from misplaced embryonic cells of the fat capsule (Alsberg 1892) or whether the fibroblasts of the interstitial tissues of the kidney could undergo metamorphosis into fat cells (Warthin 1897) is a point which could not be decided on present evidence. The enlarging intrarenal lipoma will occupy very much the same bed as the lipoma originating in the perinephric fat.

Reviews of large series of cases are in general agreement as to the histologic features of these lipomas. Thus von Wahlendorf (1921) found in a review of 165 cases seventy cases (46 per cent) of pure lipomas, thirty-one cases (20 per cent) of fibrolipomas, sixteen cases (10 per cent) of myxolipomas, fifteen cases (10 per cent) of fibromyxolipomas and twenty-one (14 per cent) were undergoing sarcomatous change. Albarran and Imbert (1903) in fifty-eight cases found twenty-two lipomas, six lipomyxomas, twelve fibromyxolipomas, one myxoma and seventeen with sarcomatous changes.

The average age in the series of Pemberton and McCaughan (1933) was 49.3 years; the youngest was twenty-eight and the oldest sixty-eight. Lecéne (1909) in thirty-three cases found that the average age was forty to fifty years. In this series there were 70 per cent women.

The most disturbing feature of these tumors is the high mortality in the recorded cases, a feature all the more noteworthy if it is remembered that the successful cases are more likely to be published. More careful selection of cases for operation might perhaps lower this formidable mortality rate. Thus in some of the recorded cases the tumor was undergoing suppurative infection at the time of operation, a complication certain to cause a fatality from spread of infection in the large raw bed left after extirpation of the growth. Tumors with sarcomatous infiltration of vital structures would be beyond surgery. The successful cases are those in which

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FIG. 1. X-ray plate showing outlines of two normal kidneys and cecum, ascending colon, transverse colon and splenic flexure in normal position as shown by their gas shadows.

enucleation of the tumor was possible, enucleation including partial or complete nephrectomy in the case of intrarenal lipomas.

CASE REPORT

P., a male Singhalese aged two years two months, was admitted to the Lady Ridgeway Hospital for children on November 6th, 1946, because of a tumor in the abdomen. On examination the child had a large intra-abdominal tumor roughly centered on the umbilicus. It lay transversely across the abdominal cavity and was oval in shape with a constriction in the middle line, the right pole filling the loin and extending from just below the costal margin to the right iliac fossa while the left pole reached the left loin. The tumor was well defined, rounded and painless; it could be moved freely from side to side but not from above downward. It was soft and fluctuant and the percussion note was dull. A length of bowel was palpable on its upper margin, the bowel being tethered to this margin. The child was not well nourished but was otherwise in good health. An x-ray picture demonstrated the outlines of both kidneys which were of normal size. The gas shadows of the cecum, ascending colon, transverse colon, and desending colon were visualized in their normal positions. (Fig. 1.)

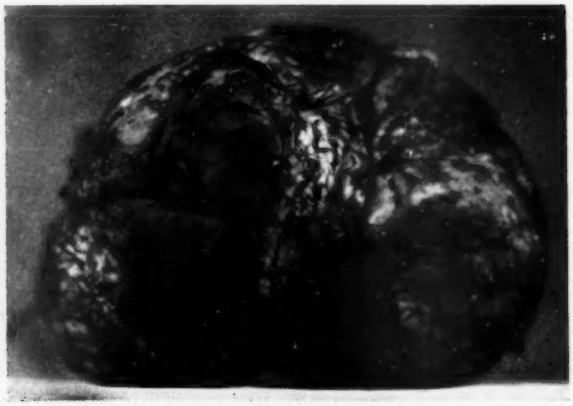

FIG. 2. Photograph of the tumor.

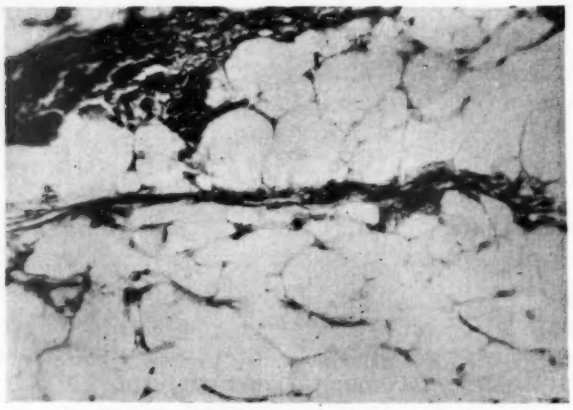

FIG. 3. Photomicrograph of tumor.

The growth was considered to be a large retroperitoneal tumor, probably non-malignant, and from its position possibly a large cyst originating in the ileocecal angle. In view of its size operative removal was advised.

An operation was performed under general anesthesia on November 20, 1946. A horizontal incision just below the umbilicus was made from the right loin to beyond the outer edge of the left rectus muscle. The muscles to the right of the right rectus muscle were split in the direction of the incision as in McBurney's incision. The right rectus muscle and its sheath were divided transversely in the line of the incision. The sheath of the left rectus muscle was also divided in this line, the left rectus muscle being retracted outward. A good exposure of the lower peritoneal cavity was obtained, and a large, lobulated, yellow retroperitoneal tumor was seen lying across the abdominal cavity deep to the large and small intestines and their mesenteries, and superficial to the inferior vena cava and the aorta.

An incision was made over the tumor through the posterior parietal peritoneum below the

ileum and to the right of the mesentery of the pelvic colon. A finger cautiously separated the retroperitoneal tumor from its bed, a maneuver calling for great care in view of the close relationship of the front of the tumor to the blood vessels of the large and small intestines. When the tumor had been enucleated, the right kidney and ureter were exposed on the posterior wall of the tumor bed. There was some oozing from the bed, which was arrested with gauze pressure. The incision in the posterior parietal peritoneum was closed and the wound of the abdominal wall sutured without drainage. The only muscle which had been divided, the right rectus, was repaired with catgut sutures. The pulse immediately after the operation was 150 and of a poor volume. Plasma, 100 cc., was given by slow drip intravenously. Five hours later the child was quiet and had a good pulse.

On the next day there was distention of the abdomen, which was partially relieved by emptying the stomach of gas and muddy fluid via a catheter passed through the nostril. On the day after the stomach had no residual fluid and the abdominal distention subsided in the next few days. The patient left the hospital in good health on December 5, 1946.

The specimen removed was a large, lobulated, oval lipoma with a constriction in the middle where the mesenteric vessels overlaid it. (Fig. 2.) Report on microscopic section of the tumor: "The section showed fatty tissue." (Fig. 3.)

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New Instruments

NEGATIVE PRESSURE UNIT

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THE following is a description of a negative pressure unit developed at the Orange Memorial Hospital, Orange, New Jersey, to eliminate many of the disadvantages of the original Wangensteen suction apparatus.

FIG. 1. Final design of negative pressure unit developed by author.

Negative pressure is obtained by means of a 20-watt, slow speed, eddy current induction motor which will give many hours of continuous operation when necessary. A regulator and gauge have been developed which deliver the degree of vacuum desired from 0 to 150 mm. of mercury. A two-quart collection bottle is provided which is visible and readily available for emptying.

The pump is started with a switch after plugging into an electric outlet. By turning the tester button to the right the degree of vacuum is immediately registered on the gauge and may be adjusted to the desired value by means of the regulator which is then secured with a lock nut. When the tester button is released, the pump will evacuate the bottle to the degree of vacuum selected. The rubber tube leading from the collection bottle is then connected to the Levine tube and the machine is in operation.

A T connection is usually placed at the end of the Levine tube with the third connection of the T closed off. A clamp is provided at the bottle to shut off the vacuum so that water or liquid medicants may be administered to the patient with a syringe through the third connection of the T, back through the Levine tube to the stomach. This also provides a method of cleansing any obstruction that might occur in the Levine tube during the normal operation of the apparatus.

The two-quart bottle is usually emptied before it becomes completely full; but should this be neglected, an automatic shut-off prevents liquid from being drawn through the pump. If this accident should occur for some reason, no damage would be done to the unit, as water followed by alcohol may be drawn through the pump which is then thoroughly oiled.

It has been our custom when the unit is returned to the supply room, to have it thoroughly cleaned and the pump oiled. The regulator is set for 75 mm. of negative pressure and fastened with the lock nut. It is then ready for average use on the next case and can be run continuously for four or five days without further attention other than emptying the bottle before it becomes too full.

This gives us an apparatus* which is inexpensive, light and compact and which gives more satisfactory service than others now in use. The instrument weighs but 11 pounds and

* Apparatus produced by the Burdick Corporation, Milton, Wis.

is 12 by 5 by 12 inches over all. (Fig. 1.) It takes up very little storage space, can be conveyed to the bedside by anyone on short notice, placed on a small table or on the floor if necessary and is ready to function as soon as the Levine tube is placed. The bottle is readily accessible to emptying by simply removing the stopper which carries the automatic shut-off and other connections. The automatic shut-off can be taken apart in a minute's time for cleaning if that becomes necessary.

It is interesting to note that some of the original pumps are still in use after ten years of service.

Arrangements are being made to provide an auxiliary gauge and regulator for low range control of negative pressure which might be desirable in chest surgery.

F. A. SIMMONS has performed over 200 testicular biopsies, half of them in his office under local anesthesia since 1940. The most common indication is for diagnosis in cases of male sterility. I doubt that the average surgeon has the ability or the equipment to perform this operation as a routine office procedure, however. (*Richard A. Leonardo, M.D.*)

NEW INSTRUMENT TO SIMPLIFY REMOVAL OF WATER FROM THE LIGHT CARRIER TUBE OF A BUIE PROCTOSCOPE

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Rochester, Minnesota

IT has been difficult to remove the water from the light carrier tube of a Buie proctoscope. Forcefully shaking the tube and trying to remove the water with a tiny tuft of cotton attached to the tip of a wire have failed to be satisfactory. The water left in the glass tip of the light carrier tube often diminishes the amount of light transmitted or causes the glass tip to act as a lens.

To accomplish the removal of the water, a metal tube 10⅜ inches (26 cm.) long and ⅛ inch (0.3 cm.) in diameter (Fig. 1) has been attached to a hose connection which may be inserted into Mueller suction tubing, which is a ⅛ by 11/32 inch (0.3 by 0.9 cm.) rubber tube. The rubber tube may be attached to a laboratory suction or to the suction employed to remove fluid and feces from the bowel during a proctoscopic examination. The latter arrangement will be facilitated by using a Y tube of appropriate size and an enema tube clamp to close the suction tube when the suction is used during a proctoscopic examination. We have found this tube satisfactory in the Section on Proctology of the Mayo Clinic in Rochester.

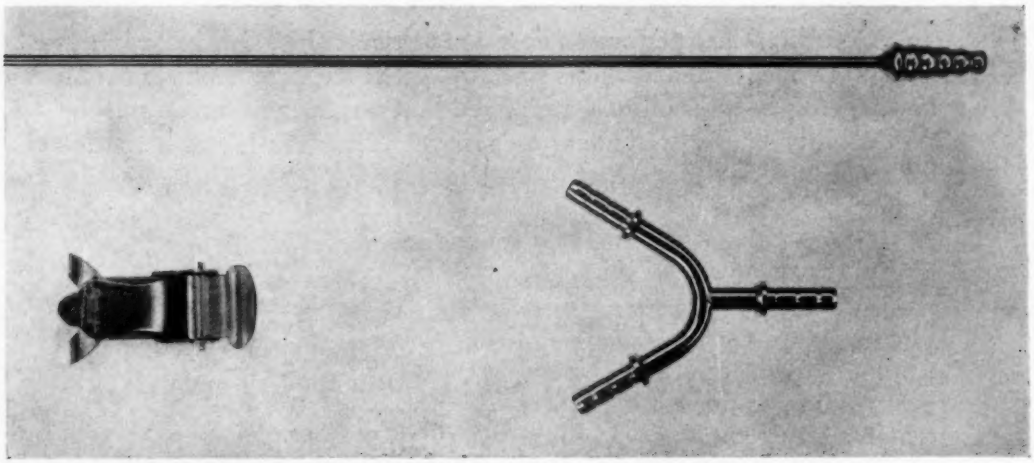

FIG. 1. A suction tube to simplify the removal of water from the light carrier tube of a Buie proctoscope; the clamp and the Y tube mentioned in the text are also shown.

AN IMPROVED MIKULICZ SPUR-CRUSHING CLAMP

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Cleveland, Ohio

THE colostomy spur-crushing clamp described herein was developed to offset the main disadvantages of the present types of parallel bar crushing clamps available (e.g., the slipping off after application and the discomfort of the patient due to excess weight of the clamp).

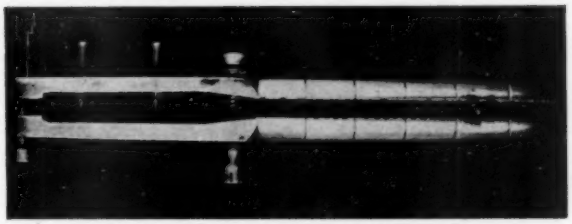

FIG. 1. Photograph of clamp showing heel screw at proximal end; ½ inch spaced depth grooves are seen on the crushing bars.

Slipping occurs because of the necessary "play" present in the guide bars of the clamp. In this small amount of "play" comes the failure of the crushing bars to stay parallel, for the distal crushing ends separate slightly while the proximal ends approach each other. Thus the clamp actually pushes itself off the spur. To overcome this inevitable slipping, an adjustable heel screw was incorporated into the proximal end of the clamp as shown in Figures 1 and 2. As the clamp is tightened on the spur, the heel screw is tightened slightly so that the distal ends are kept more snug than the proximal ends. The type of grooves on the crushing surfaces are unimportant when this heel screw is provided.

To eliminate the bulk and weight of the stainless steel, chrome or Monel Metal clamps, cast aluminum was used and the weight reduced in half. No corrosion occurs and the luster is quickly restored after use by cleaning. The clamp can be easily constructed by a good mechanic.

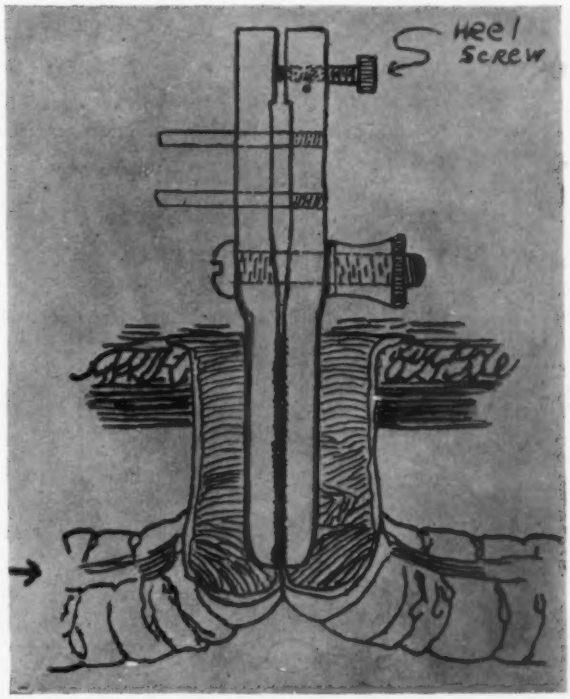

FIG. 2. Drawing showing clamp in place on spur (not drawn to proportion.)

Acknowledgment: Appreciation is extended to Mr. S. H. Thomas, mechanic, Tyler, Texas, who constructed the models now in use.

NEW, SIMPLE, COMBINED INSTRUMENT FOR UTEROTUBAL INSUFFLATION AND ENDOMETRIAL BIOPSY*

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Chicago, Illinois

AT the Cook County Hospital Out Patient Gynecologic Clinic we are constantly confronted with the problem of infertility. Because of the volume of patients, therefore by necessity, we attempt to simplify all our diagnostic procedures and instruments. Until recently the Neal, the Jarcho and other cannulas were used for the tubal patency test while the Randell or Novak endometrial curets were used for the study of the endometrium so that two distinct and separate instruments were employed.

FIG. 1. Combined tubal insufflation and endometrial biopsy cannula.

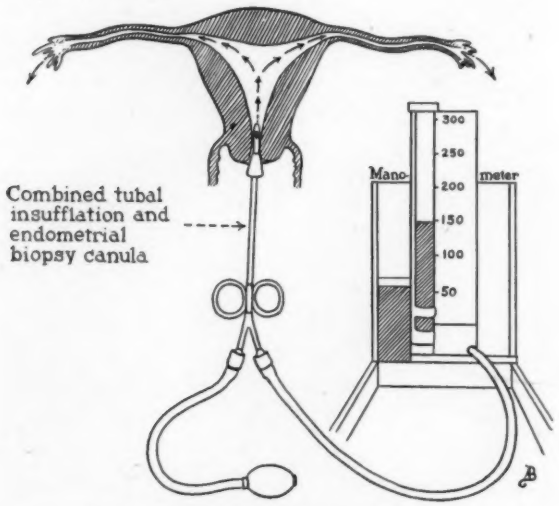

FIG. 2. Rubin test for tubal patency.

We wish to present an instrument which embodies both features in one, that is, the curet and the tubal insufflation test cannula.† It is safe, simple, effective and less expensive. The handle of the instrument makes it easier to grasp while doing an endometrial biopsy. The opening of the tip of the instrument is large enough to obtain a good endometrial specimen and will also permit easy flow of air when testing the fallopian tubes. (Figs. 1 and 2.)

Furthermore, it will not be plugged up with inspissated blood and minerals while being sterilized. The latter was a common occurrence with the Neal cannula because the openings were too small. Inadvertently, while using the latter on several occasions we failed to test the apparatus before making the patency test and have had "false negative" results because the instrument was plugged up and air failed to pass through it.

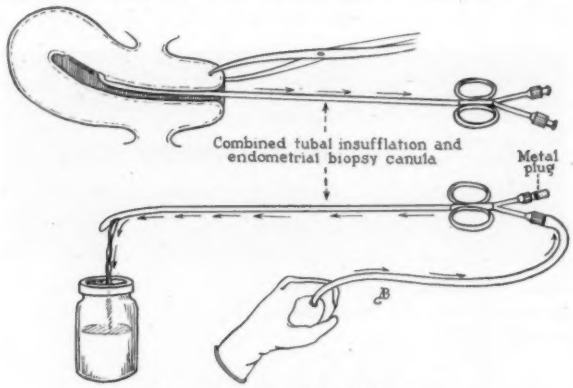

FIG. 3. Endometrial biopsy.

The instrument is made of malleable metal so that the tip may be bent; the rubber tip "acorn" may be removed entirely or moved away while doing an endometrial biopsy.

We do not use suction and believe that it is not necessary. When one scrapes the endometrium, the tissue fills the cannula with ease. It is then blown out with the rubber tube and bulb into a biopsy specimen bottle. (Fig. 3.)

SUMMARY AND CONCLUSIONS

1. A combined tubal insufflation and endometrial curet cannula is described which is safe, simple and effective.

2. We do not wish to imply that two separate tests should be made at the same time but that one instrument may be used for both tests at different times.

3. In searching the literature we failed to find a similar instrument in use.

† Instruments manufactured by the Western Surgical Instrument Co., Chicago, Ill.

* From the Department of Gynecology of The Cook County Hospital, The Gynecologic Division of Fantus Clinic, The Chicago Medical School and Cook County Graduate School of Medicine, Chicago, Ill.